THE

# ELECTRICAL REVIEW.

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THE

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## THE PROGRESS OF ELECTRICITY.

THE discussion on this subject at the monthly dinner of the London Chamber of Commerce last week was, in many respects, notable. Electrical engineers have many opportunities of debating the academic and technical problems of their art in their own places of assembly, but it is not often—we think not often enough—that they are able to give a presentment of their case in its industrial and economic aspects to the hard-headed man in the street, who has ears to hear and capacity to judge, and who, when convinced, can throw some weight into the uneven scales to adjust the balance of forces which make for rational progress.

Among a gathering of shrewd business men it followed that the discussion went down to the deeper currents responsible for the eddies upon the surface of the industry which attract the attention of the ordinary bystander. There is a place and a public for often well-deserved eulogies on the functions of the inventor, the draughtsman, the experimenter, and the executive engineer. But these (if we may summon without offence a humble analogy to illustrate our meaning) are but the tail, of which the business man with the purse strings is the dog. It is well occasionally to remind ourselves of this relative responsibility for movement between the dog and its dependent. The inventor may dazzle us with discovery; the draughtsman charm us with the design which yields an enhanced efficiency among the fifth place of decimals; the expert engineer may exhaust himself and his readers in folios of works' specifications; but the mainspring finally responsible for them and their works is the man who keeps the tally of profit and loss.

Hence it becomes interesting to follow the trend of thought of the representative men who spoke on the occasion in question for the progress of the electrical industry in its various groupings of interests—the manufacturer, the contractor, the buyer, the supply organisation, the intelligent consumer. And on doing so we trace an identity of sentiment which, in a world where men are more prone to differ than to agree, can only be accounted for by an overwhelming conviction of common danger. The story is an old one to many, and has been told a thousand times. But it is our duty to go on repeating it until it is borne in on the seats of the mighty, and they realise which way their duty lies.

In effect the matter comes to this:—That the electrical industry has for long enough been made the subject of socialistic experiment, and it is time it were given a change of treatment. The legislative doctors were called in by a few busybodies at its birth, and they bungled delivery. They then handed the child over to the Sarah Gamps of parochial collectivism, who, in their turn, have smothered it in bands of officialism, until, like a Chinawoman's toes, natural development has become almost past praying for. No doubt there may yet be found champions of the cause of munici-

palisation who will deny this. To such we would point out the indisputable advance of electrical progress in the United States and Germany, ahead, and far ahead, of that in Great Britain, and add that in those countries the municipalisation of electricity for light, traction, and power, has never been an article of legislative faith. Twenty years ago these three leading industrial countries of the world had identical opportunities of a fair start on the course of electrical development. Indeed, any advantage there might be assuredly lay with Great Britain, whose traditions, experience, and organisation in allied branches of industry were unequalled. To-day, after nearly a quarter of a century of trial, the dullest are awakening to the unpleasant reality that not only are our producers out-manœuvred and under-sold in the world's neutral markets, but on our own ground the public are in arrear of other countries in the benefits of applied electrical science. Our manufacturers are now criticised for their sloth; our capitalists for their want of enterprise. But this is mistaking effect for cause. It is not the individual, but the system, which is the cause of the present distress.

At the present time this country is again rising on a wave of industrial expansion; and in no department of its commerce is the outlook so promising as in that of the electrical industry. There are signs that we are at the dawn of a long and brilliant day which will witness the gradual substitution of electrical energy for the existing lighting and motive power agencies of the world. On the one hand, the Legislature will have to consider, in the ensuing session, projects for electric traction and electrical power distribution, initiated and supported by private enterprise, which will be far-reaching in their benefits to the public and to the industrial community.

On the other hand, it will have to weigh the stubborn opposition of local authorities to these measures, and their efforts to widen the scope of their functions by securing powers to engage, not merely in the management of well-established prime necessities, such as water, sanitation, and education, for the common benefit, but in hazardous undertakings of a trading character, which demand not only expert knowledge and continuity of management, but involve sectional advantages among classes of ratepayers.

Mr. Sydney Morse furnished figures to the Chamber of Commerce which illustrate the magnitude of the interests at stake, and the futility of the argument that electrical enterprise had, as a whole, prospered in the hands of local authorities. Mr. Garcke spoke of the inevitable consequences which must follow on the premature municipalisation of electric traction. Mr. Percy Sellon pointed out the influence which the policy of the past had exercised in stunting the growth of the electrical manufacturing industry, depriving it of profit, and involving the producer in a multiplicity and confusion of designs. Other speakers were of one mind in confirmation of their views.

The recommendations of the Joint Electrical Committee of the Houses, formulated last summer, go to the pith of the present matter, and point the way for the future. It is not unreasonable to hope that the spirit which prompted them will animate the Legislature as a whole in laying down the lines of its future policy; and that they will realise that beneath a belly of brass the idol they set up two decades ago has been shown to be reared on feet of clay.

## THE TELEPHONE SERVICE.

The Telephone Service has been the subject of much criticism, and the proper steps to be taken in regard to it is the subject of much controversy. Except in Parliamentary inquiries or shareholders' meetings, the company has maintained an attitude, if not of dignified silence, at least of masterly reserve. The silence is at length broken, "the case of the National Telephone Company" having been presented to the readers of the *Times* in a series of articles "from a Correspondent," the substance of which we give in another column. The appearance of these articles seems to imply that we are reaching a critical stage in telephone affairs, and the tendency shown in them to "go for" the Post Office indicates the not unusual tactics of carrying a war into the enemy's country, and singles out the Post Office as the enemy. The criticisms of the company have not come from the Post Office, and it is by no means safe to say that the criticisms of the Post Office by the company are well founded. It may be true that the Government could have acquired the telephone patents and undertaken the work themselves, but because they did not do so it does not follow that their action was unwise. In small things as in large, it is sometimes more convenient and sounder policy to work through a "chartered company" than to undertake immediate responsible control.

Sooner or later the responsibility has to be assumed by the Government direct, but the intervening period is not always wasted time, or the subsequent increased payment wasted money. It seems to us that the National Telephone Company, as the pioneers of an undeveloped enterprise, have claims to favourable consideration, which are too strong to need, on their part, a carping criticism of Post Office policy. It is possible, however, to discern a sense of ill-treatment, which may be the prompting source of the attack on the Post Office.

The National Company allege that the arrangement or understanding as to the absence of competition led to their surrender of the trunk lines, and they state in so many words that the lines would not have been handed over but for such an understanding, and they regard the policy of competition as a breach of faith.

It is unfortunate for the National Company that a Parliamentary Committee, with opportunities of taking evidence, has reported that no impediment to competition exists. At the same time there is obvious force in the statement of the company that its surrender of the trunk lines was a weakening of its position, and it is reasonable to infer that it should seek some compensation. Whilst all agreements have specifically reserved the rights of competition, it may be that the company was content with assurances of their existing policy, but in the absence of a record in a treaty these assurances do not avail them. On the part of a Government of a civilised country full effect must be given to any reasonable understanding between private individuals and responsible officials, providing such understanding be not contrary to the public policy. It seems to us that in its attack on the Post Office and the recent Committee the National Telephone Company give less weight than it deserves to the public agitation which led to the formation, and, perhaps, to some of the conclusions, of the Committee.

We believe the impression to be strong that the telephone service is one which should be undertaken by the State, but we doubt whether the public are even yet ready to recognise the force of the two points to which the National Telephone Company refer—the waste of capital involved in competition and the inconvenience to the public of competing systems. It is, therefore, conceivable that competition might be embarked upon which would produce serious injury to the company, without being of immediate advantage to its competitor, though the plant might serve as the nucleus for subsequent growth. We can but repeat the opinion we have previously expressed, that in order to avoid competition, it may be well worth the while of the company to sell at a price which seems to them low, and for the State to purchase at a price which may seem to them high. Under any circumstances, the telephone service should be removed as quickly as possible from a position of uncertainty, and be emancipated from the restrictions which are shown to hamper its existence. The case for the company contains ample evidence of the desirability of Government purchase. With a limited tenure the company cannot be expected to expend capital, and with no wayleave rights, they must necessarily be hampered and delayed in the connection of their subscribers. Telephonic communication is of too great importance to be allowed to remain long under such bans. The Government has the powers, the credit, and the skill needed to develop the service to the public advantage, and can well afford to deal fairly with the company.

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The Barking Explosion.

Nothing very satisfactory has so far been elicited as to the cause of the explosion. Mr. Stromeyer, who was of opinion that the pressure was very high, gave reasons for his opinion, such as the distance to which pieces were thrown, and the air pressure generated at a distance sufficient to break windows, and which must have emanated as air waves at a centre of pressure such as he stated. There was a stop pin in the gauge, and the inference is that the 16 lbs. shown by it was only 16 lbs., and not 16 lbs. on the second time round, whence we would infer that the gauge tube must have been stopped—perhaps by a lead washer as we suggested last week. It appears that the boiler shell was welded, but the tears were through the solid plate proving good welding. The top of the boiler evidently went first, for Mr. Stromeyer noticed that the boiler was severely pressed down upon its seat, and a hole 9 inches by 2 feet had been caused thereby. Altogether, he showed many reasons to suspect a pressure of 400 lbs. or more, and the most likely conclusion we can at present draw is that the pressure gauge was misleading, and the safety valve spring had been screwed down heavily, while the amount of the fire in the boiler must have been greater than any of the attendants realised. A recent story in an all-true magazine described how a boiler got up an enormous pressure in a few minutes, and gave evidence of this excessive pressure by making "frantic lunges" at its attendant. No such evidence was afforded by this Barking boiler, which simply sat still till it had to burst. The wonder is that nobody seemed to have tested the water gauge cocks, which would surely, either in the colour of the steam discharged or in the noise and energy of its outflow, have given some indication of a pressure above the 16 lbs. of the gauge. If possible, it would be desirable to secure evidence as to the weight of coal burned in a given time, for if much coal was consumed it is clear that a corresponding amount of heat must have entered the water, and it might appear that the pressure was probably above the 16 lbs. by a very considerable amount. The total heat of water would be considerably more at the high pressure, also of the steam of which the boiler would contain at 400 lbs., about 14 times as much as at 16 lbs. (by gauge). Has the steam gauge been found? This should be carefully tested and carefully opened in the presence of two or three engineers. It may disclose some cause for the great difference between its reading and the suspected actual pressure.

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A True Verdict at Last!

While Keely lived he succeeded in fleecing many believers in his sincerity, on both sides of the Atlantic. In the columns of the Electrical Review and a few other journals he was described in a true light, and the strongest terms used with regard to his work of deception have been shown to be thoroughly deserved. In a general sense one feels inclined to say as little as possible about the sins of any man after he is dead, but in the case of so gross a charlatan and impostor as Keely was, we think an exception is warranted. When the daily press announced his death a short time ago, it bewailed the fact that his "secret" had died with him. Subsequent investigation by American scientists has revealed the wonders of the Keely force. "Tubes skilfully concealed in the walls and floors of his laboratory were evidently used to convey compressed air to his wonderful motor. Instead of having discovered a new force in nature, as Keely always claimed, he had simply driven his machinery by compressed air, and most adroitly humbugged the public." The late Mrs. Bloomfield Moore, who was so loud in her praises of Keely and his work, is said to have been a genuine believer therein, and to have paid him many thousands "to pursue his investigations." What prevented the more complete exposure of Keely during his lifetime was doubtless the support he received from those who ought to have known better. One cannot but regret that he was not brought to the bar of justice while he lived. However, the world now brands him "a colossal fraud." One is inclined toward cynicism when the public shows its love for being gulled in this way. May we venture to hope that the last complete exposure will help to place it more upon its guard, and lead it to attach more importance to legitimate criticism?

---

**Method of Strengthening Steam Pipes.**—A simple method of strengthening copper steam pipes was described in a paper by Mr. T. Messenger before the N.E. Coast Institute of Engineers and Shipbuilders. It consists in applying a series of bands, or rather half bands, with cottered connections. In a 12-inch pipe these bands have been applied for a pressure of 110 lbs. at distances apart of 6 inches centre to centre. They have a section of 2 inches by $\frac{3}{16}$ inch. Obviously, the great advantage of such bands is the restraining effect upon a rupture of the longitudinal brazed seam. Ordinarily, if a seam gives way at a faulty portion, the tear is likely to open up to the nearest flanges each way. With bands a tear will not exceed about 4 inches in length. By means of suitable flanges and double bands attached thereto these bands can be applied to a pipe at any branch junction where a pipe is necessarily weaker than elsewhere. The appliance is well devised and should certainly find a large field of usefulness in strengthening the copper pipes of many vessels, though we hope new vessels will abandon brazed copper for steam pipes and adopt steel or wrought-iron or solid copper. The failures of brazed pipe have been too numerous and serious for the radical effects of brazed pipes to be longer allowed to remain a source of danger.

D

## THE MAGNETIC PROPERTIES OF TEMPERED STEELS.

(*Concluded from page* 76.)

*Stability of the Magnetisation of Steel Bars.*—Demagnetisation arises from several causes, of which Mme. Curie considers four:

The action of shocks, blows, or vibration.

Changes of temperature.

Magnetic fields due to magnets or currents in the neighbourhood.

Time, the magnet changing spontaneously.

*Effect of Prolonged Heating.*—MM. Barus and Strouhal have studied this question with great care, have shown the necessity of prolonged heating at a very moderate temperature, and have ascertained that the stability of magnetisation is improved by partial demagnetisation after saturation. The authoress has made many experiments on the effects of heat on magnets, and gives in a table the results of three series of experiments. One series was carried out on 15 bars of hardened steel of various kinds, heating them for 10 hours at 100°, and then for three hours at 200°. The second series was carried out with greater care on three bars only, a carbon steel of ·84 per cent., a bar of Allevard steel, and a bar of molybdenum steel, which were heated at 100° for 24 hours, and afterwards for 15 hours at 150° and 200°. The results of the two series were similar, and showed in nearly every case a considerable loss both in magnetisation and coercivity. The exceptions are very mild steels, and Boehler's boreas steel, in which the residual intensity was increased by the heating. In boreas steel, $I_r$ was increased from 385 to 434, *i.e.*, 13 per cent., by three hours' heating at 200°, the value of the coercivity falling, however, from 80 to 55. The final figures only are given here :—

| | Carbon steel. | | Allevard steel. | | Molybdenum steel. | |
|---|---|---|---|---|---|---|
| | $H_c$ | $I_r$ | $H_c$ | $I_r$ | $H_c$ | $I_r$ |
| Percentage loss after heating at 100° | 13 | 8 | 12 | 6 | 12 | 4 |
| " " " 200° | 41 | 27 | 47 | 33 | 50 | 11 |

The third series of experiments was carried on at a temperature of 60° only for several days, on bars of Allevard, boreas, and molybdenum steels. The coercivity was in every case reduced by this process by about 1 per cent., and the residual intensity in some cases increased, in one diminished, by the same amount. Mme. Curie concludes that the prolonged heating found to be desirable by MM. Barus and Strouhal must be at a temperature not exceeding 60° to 70°, since in all steels, and that to a greater degree as the material is more suitable for magnets, heating at a temperature of 100° or upwards reduces materially the coercivity, the very quality that principally makes for stability. In some steels, notably in Boehler's boreas steel, prolonged heating at 200° greatly increases the magnetisation, even while largely reducing the coercivity, and it may be inferred from this that closed rings of this steel would gain very greatly in intensity by prolonged heating. The property, however, though curious, does not seem to be valuable from the point of view of permanent magnets.

*Action of Shocks and Vibration on the Magnetisation of a Bar.*—The shocks used in these experiments were produced by dropping the bars, which were first allowed to fall in an upright position from a height of 85 cm., and afterwards in a horizontal position from 30 cm., on to a pavement of hard cement, the two kinds of fall being repeated alternately. The shocks received did not modify the nature of the steel, since the coercivity and capacity for magnetisation were unchanged. The effect of the shocks on the magnetisation has alone to be considered, and for this purpose the intensity at the middle of the bar was measured about 2 minutes after magnetising to saturation, and afterwards in the intervals between successive falls. The first falls produce the greatest effect, and the succeeding ones less and less, the intensity of magnetisation tending asymptotically towards a limiting value inferior to the initial one. The phenomenon is sometimes irregular; occasionally after several falls have made no change at all the next ones may slightly diminish the magnetisation as if a new set of particles had been reached. The observations on a number of bars are tabulated in the original paper, those on bars of the same dimensions, which alone are comparable, are classed together. The following are some of the principal results :—

EXPERIMENTS ON BARS.—20 cm. × 1 cm. × 1 cm.

| — | $H_c$ | $I_r$ | Loss per cent. of magnetisation. | Number of effective blows. |
|---|---|---|---|---|
| Allevard steel ... | 73 | 560 | 5·0 | 50 |
| Molybdenum steel | 85 | 520 | 3·2 | 10 |
| Boreas steel ... | 86 | 390 | 1·5 | 5 |

The fourth column shows the number of blows required in each case to produce the stable condition, when no further effect is produced, and it is seen that these are fewer as their effect is smaller, and the coercivity is larger. With boreas steel, where the coercivity is large, the total effect producible by the shocks and the number of shocks required to produce the final condition are both very small. In mild steel on the other hand, where the coercivity is very small, the final condition was not reached even after 95 blows. The shocks were sufficiently severe to break the bars in some cases, and no hammering with a copper hammer produced any further effect. In the same table in which the above results are given, Mme. Curie gives figures showing that bars whose coercivity has been reduced by heating at 100° and 200° are rendered more easily demagnetisable by shocks.

*The Effect of Shocks on Bars Partially Demagnetised.*—Experiments were made on a magnetised bar of Allevard steel of 20 cm. × ·85 cm. × ·85 cm. :

| | Intensity of magnetisation. |
|---|---|
| Bar magnetised to saturation ... ... ... ... | 676 |
| After a great number of falls ... ... ... ... | 658 |
| Remagnetised and partially demagnetised in a field of 6·4 units ... ... ... ... ... | 660 |
| After a great number of falls ... ... ... ... | 656 |
| Remagnetised and still more demagnetised in a field of 14 units ... ... ... ... ... | 632 |
| A great number of falls produced no sensible effect | 632 |

Experiments with a bar of mild steel (·5 per cent. carbon) of 20 cm. × 1 cm. × 1 cm. :

| | Intensity of magnetisation. |
|---|---|
| Bar magnetised to saturation ... ... ... ... | 200 |
| After a great number of falls ... ... ... ... | 152 |
| Remagnetised and partially demagnetised in a field of 8·5 units ... ... ... ... ... ... | 150 |
| (This bar still lost magnetism from falls.) | |
| Remagnetised and still further demagnetised in a field of 13·8 units ... ... ... ... ... | 118·4 |
| The magnetisation then increased spontaneously for 4 days up to... ... ... ... ... ... | 123 |
| (Afterwards it remained constant, and could not be affected by blows.) | |

Thus in partially demagnetising the bars one renders the effect of the blows less sensible. The bar of Allevard steel became completely insensible to blows after about 6 per cent. of its saturated intensity has been removed by demagnetisation in a field of 14 units. Thus one can render the magnetisation of bars proof against blows by partial demagnetisation, a process at once easier and less dangerous to the magnet than dropping it an indefinite number of times on a hard floor. For bars of 20 cm., in length by 1 cm. square, Mme. Curie repeatedly found a demagnetisation of 10 per cent. sufficient to protect them against all loss of magnetisation from blows or shocks.

*Effect of Prolonged Heating at a Low Temperature before Magnetisation.*—Mme. Curie found that prolonged heating in addition to partial demagnetisation is beneficial, and gives an instance of a bar which, after being demagnetised from $I = 580$ to $I = 528$, fell under prolonged heating at 60° till I was only 510. After this treatment, however, it was again saturated to $I = 580$, and demagnetised to $I = 519$, and then retained this value of I against all further heating at 60°. Whether, however, this was due to the preliminary heating at 60° before the second saturation, or to the greater extent to which the demagnetising process was carried on the second occasion, is not quite clear.

*Variation of the Intensity of Magnetisation of Bars with Temperature.*—A bar magnet of hard steel baked at 60°, then magnetised to saturation, and demagnetised by 10 per cent. of its value, possesses an intensity which is always the same at any particular temperature, but falls as the

temperature rises, and rises as the temperature falls: so that its temperature coefficient is negative. The changes are small and difficult to measure, but are about ·02 per cent. per degree C. for Allevard steel, and about ·03 per cent. for molybdenum steel. The results of the experiments are as follows:—

Bar of Allevard Steel.

| | | | $I_r$ |
|---|---|---|---|
| Maximum residual magnetisation | | ... ... ... ... | 36·50 |
| Bar demagnetised in a field of 13 units. | 1st series | at 17° ... ... | 32·06 |
| | | about 45° ... ... | 31·88 |
| | | at 17° ... ... | 32·08 |
| | 2nd series | at 17° ... ... | 31·81 |
| | | about − 10° ... ... | 31·99 |
| | | at 17° ... ... | 31·83 |
| | | about − 10° ... ... | 31·99 |
| | | at 17° ... ... | 31·82 |
| | | about 45° ... ... | 31·68 |
| | | at 17° ... ... | 31·81 |

Bar of Molybdenum Steel.

| | | | $I_r$ |
|---|---|---|---|
| Maximum residual magnetisation | | ... ... ... ... | 31·17 |
| Bar demagnetised in a field of 21 units. | | at 17° ... ... | 27·66 |
| | | about 45° ... ... | 27·50 |
| | | at 17° ... ... | 27·67 |
| | | about − 10° ... ... | 27·93 |
| | | at 17° ... ... | 27·66 |

*Changes of Magnetisation produced by External Magnetic Fields.*—In order to reduce the intensity of magnetisation of a bar by a given fraction of its value, it is generally necessary to employ a stronger field according as the coercivity of the bar is greater. The following table gives the strengths of field in which different bars must be momentarily inserted in order permanently to reduce their maximum magnetisation by 10 per cent.:

| | | | | |
|---|---|---|---|---|
| A field of | 3·5 | units for a carbon steel (·5 % carbon), | having a coercivity | 21 |
| „ | 13·5 | „ „ Allevard „ | baked at 60° having a coercivity | 70 |
| „ | 13· | „ „ „ „ | not baked having a coercivity | 71 |
| „ | 27·5 | „ „ Boreas „ | baked at 60° having a coercivity | 78 |
| „ | 21· | „ „ molybdenum steel, B, | baked at 60° having a coercivity | 80 |

The field necessary to demagnetise by 10 per cent. the bar of boreas steel is remarkably intense.

Mme. Curie examined the disturbing action of a magnetic field acting temporarily in one sense or the other on the last four bars after they had been magnetised to saturation and then demagnetised by 10 per cent. She found that fields inferior to those that had been already employed to effect the 10 per cent. reduction produced variations of only ·1 per cent. to ·3 per cent., while stronger fields produced considerable variations. Thus the variations were less than ·3 per cent., when the disturbing field was less than 13 for the bar of Allevard steel, less than 27 for the bar of Boreas steel, and less than 21 for the bar of molybdenum steel, B. If the steel is to be demagnetised by more than 10 per cent., the demagnetising field required for the purpose as well as the disturbing field required to produce large additional variations must be greater; but then the disturbances produced by feeble fields are also increased. For instance, in the case of a bar demagnetised by 37 per cent. and 64 per cent. from its maximum intensity by demagnetising fields of 40 and 68 units respectively, a disturbing field produced permanent variations of ·3 per cent. and ·6 per cent.

A process which for all degrees of demagnetisation gives good results consists in partial demagnetisation by placing the bar successively in fields of opposite senses and of gradually decreasing values. By this operation the bar is brought into a condition in which its variations under the action of weak fields are still further reduced. This kind of demagnetisation is readily produced by a coil carrying an alternating current reduced little by little to zero by means of a rheostat.

*Conclusions on the Treatment of Magnets.*—To render a magnet as far as possible immune to all these disturbing actions without reducing its magnetisation too much, the best plan is to bake it, after hardening, at a temperature of 60° or 70° for a long time, say, 48 hours, and then after magnetising as intensely as possible, partially to demagnetise it. For bars 20 cm. × 1 cm. square, it is sufficient to demagnetise 10 per cent., and the magnet can then bear heavy blows, as well as changes in the surrounding temperature, without any appreciable loss of intensity. The stability will be greater if the magnetisation is reduced even further, but it is never absolutely independent of the action of external magnetic fields. One can, however, so manipulate it that fields up to five units will not produce greater changes than ·2 per cent., and fields up to 16 units greater changes than 1 per cent. In any case the neighbourhood of other magnets is dangerous. A pole of 500 units at a distance of 10 cm., may produce a serious effect.

Mme. Curie concludes by a warning that her rules cannot be relied on to give good magnets in all cases, though they will generally be effective, and only the lapse of time can prove the stability of a magnet beyond doubt. A final table, which we do not reproduce, gives a chemical analysis of all the steels experimented with.

## ELECTROLYTIC DECOMPOSITION OF AQUEOUS SOLUTIONS.

(*Concluded from page* 13.)

In a similar way it was found that the same E.M.F. was necessary and sufficient for the electrolysis of solutions of the bases, although the point of decomposition is not nearly so well marked. The irregularity at 0·6 volt, on the other hand, was much more pronounced. Whilst the evolution of hydrogen at the small electrode (cathode) can easily be seen at about 1·11 volts, when acid solutions are electrolysed, this could only be detected at 1·38 volts in N−Na OH solution.

The author ascribes the reason for this to the fact that in acid solutions there are a large number of H ions, whilst in solutions of bases there are scarcely any; and he further embodies this in the following fundamental rule, which has been of great assistance in the study of electrolysis.

*In order that the point of decomposition of an ion may be well marked, it is necessary that it should be present in the solution in relatively large quantity.*

Increase in concentration in solutions of the bases, requires a slightly increased E.M.F. to produce electrolysis, in accordance with what was found respecting the influence of concentration on the E.M.F. of the gas battery. In the case of ION − NaOH the E.M.F. necessary was 1·095 volts.

When the electrolyte consisted of salt solutions, curves exhibiting several breaks were obtained, so that no one could speak of a regular series of points of decomposition. On electrolysis, $K_2SO_4$, furnishes acid at one pole and base at the others, so that the variable opposing E.M.F. which results, does not permit of such a clear insight into the phenomenon. If, however, the solutions are acidified or made alkaline, the same results are obtained as before.

Hitherto the small platinum point has always been employed as cathode, but an equally important set of results was obtained by making it the anode. When acid solutions were placed in the cell, the first indication of electrolysis was observed at about 0·6 volt, but, when bases were investigated, a sudden break occurred at exactly 0·590 volt, which was even more sharply defined than the break at 1·08 volts, when the experimental electrode was cathode. This explains the apparently abnormal behaviour already referred to. The break at 0·590 volt occurs both in the case of acids and of bases, and hence it must be a point at which a particular ion separates out; and, further, by applying the rule already laid down, it must be an ion.

Now, the only possible anions in (*a*) $H_2SO_4$ are $\bar{H}SO_4$, $\bar{\bar{S}}O_4$, $O\bar{H}$, and $\bar{\bar{O}}$, whilst in the case of (*b*) KOH they are $\bar{O}H$ and $\bar{\bar{O}}$, provided we consider water as a weak dibasic acid which splits off its first H ion much more easily than the second, thus:—

$$H_2O = \dot{H} + \bar{O}H$$
$$\bar{O}H = \dot{H} + \bar{\bar{O}}$$

Up to the present, however, oxygen has always been supposed to take part in electro-chemical reactions as if it were

hydroxyl. The anions common to the acid and alkaline solutions are the anions of water, and since the $\bar{O}H$ ions are present in enormous quantity in the solution of alkali, we must conclude that the point of decomposition, 0·59 volt, is the point at which the $\bar{O}H$ ions give up their charge when they are at liberty to react on each other, thus: $4\,OH = 2\,H_2O + O_2$, producing water and oxygen.

If two similar platinum electrodes are used, the E.M.F. necessary to produce an appreciable electrolysis will thus be the sum of 1·08 + 0·59 = 1·67 volts, *i.e.*, the value previously observed by Helmholtz, Le Blanc, and others.

On the other hand, a visible evolution of hydrogen at the cathode at 1·08 volts, has been confirmed, and consequently a corresponding quantity of some other ion must have separated out at the anode. Since the conditions, as determined above, do not admit of the discharge of hydroxyl-ions, the author concludes that doubly-charged O ions must have separated out. There are thus two points at which water is decomposed, viz, at 1·08 volts, and at 1·67 volts. In each case hydrogen is discharged at the cathodes whilst $\bar{\bar{O}}$ is discharged at the anode at the lower value, and $\bar{O}H$ at the higher. The process of $H_2O$ formation in the gas battery must therefore be represented thus:—

$$2\,\dot{H} + \bar{\bar{O}} = H_2O,$$

where the oxygen, by means of the platinum black, goes into the solution as doubly-charged O ions.

III.—THE DECOMPOSITION OF DISSOLVED SUBSTANCES.

In the third part of the investigation, the author examined the behaviour of solutions when the E.M.F. employed, exceeded 1·08 volts. From a consideration of the theory, it follows that if only one anion or one cathion is present in solution, then only one point of decomposition can exist.

In water, for example, the only possible cathions which can be present are the H ions, and, since this also applies to dilute $H_2SO_4$, it follows that, with respect to the cathions there can only be one point of decomposition, viz, 1·08 volts, and that if the E.M.F. is increased above this amount, the curve must remain linear and equally inclined to the abscissæ axis without exhibiting any other break. This was found to be the case on increasing the E.M F. up to 2·29 volts. The different quotient, $\frac{d\,i}{d\,e}$, representing the change in the intensity of the current with the alteration of the E.M.F., remained constant, above 1·08 volts, within the limits of experimental error.

There are, however, several anions in sulphuric acid, so that with respect to the oxygen polarisation, a different behaviour is to be expected. The curve begins to rise gently at 0·59 volt, and at about 0·9 volt a sudden break occurs and it becomes very steep. At the same time a continuous evolution of minute bubbles of oxygen takes place at the platinum point. The anions, $\bar{\bar{O}}$ and $\bar{O}\bar{H}$, have already been discussed, so that we have only to consider the anions $H\bar{S}O_4$ and $\bar{\bar{S}}O_4$. One of these must have occasioned the break at about 0·9 volt. Now dilute (0·1 N – $H_2SO_4$) $H_2SO_4$ contains relatively more $\bar{\bar{S}}O_4$ ions than $H\bar{S}O_4$ ions, so that the break in all probability is due to the $\bar{\bar{S}}O_4$ ions. This assumption was confirmed by employing a solution of magnesium sulphate acidified with dilute $H_2SO_4$. Such a solution contains practically only $\bar{\bar{S}}O_4$ ions, and the break was found to take place at 0·87 volt. The conditions necessary for the formation of persulphuric acid, $H_2S_2O_8$ (viz., a concentrated solution of the acid and a high current density) also favour this view, but it is still uncertain whether the doubly-charged ion gives up only one of its charges, or whether it gives up both and then reacts with water, in the following way:—

$$2\,SO_4 + 2\,H_2O = 2\,H_2SO_4 + O_2.$$

If it be granted that 0·87 volt is the point at which $\bar{\bar{S}}O_4$ ions give up their charge in normal solution, there must be still another break at the point where the $H\bar{S}O_4$ ions are discharged. By applying the rule already laid down, we must so arrange matters that a relatively large number of $H\bar{S}O_4$ ions are present. This is best attained by saturating 8 N – $H_2SO_4$ with $KHSO_4$, since, in this way, we obtain a solution which contains any $\bar{\bar{O}}$ ions, whilst the quantity of $\bar{O}H$ and $\bar{\bar{S}}O_4$ ions is reduced to such an extent that it becomes relatively small when compared with the number of $H\bar{S}O_4$ ions present. On electrolysis it was found that a copious evolution of oxygen only took place at 1·6 volts.

Careful experiments showed that the exact point at which the break occurred was 1·57 volts, so that this may be accepted as the point at which the $H\bar{S}O_4$ ions give up their charges. Besides the ions already considered, there are no others possible, either in a more concentrated or in a more dilute solution, so that we can assign to each ion its own place. Thus, putting the E.M.F. necessary for the discharge of $\bar{\bar{O}}$ ions, equal to 1·08 volt ($\dot{H}$ = O), we have the following points of decomposition:—

$\bar{\bar{O}}$ = 1·08 volts.
$\bar{O}H$ = 1·67 „
$\bar{\bar{S}}O_4$ = 1·95 „
$H\bar{S}O_4$ = 2·65 „

all of which apply to a normal solution, excepting the last, which refers to a more concentrated solution (8 — — normal).

Above 2·7 volts, therefore, there is no further break in the continuity of the curve, *and we now have an explanation of the fact that the maximum polarisation of dilute $H_2SO_4$ is about 2·7 volts.*

The author points out that similar results are to be expected on investigating all other acids and bases, and he also refers to the possibility of rapidly performing analysis by simply measuring the points of decomposition.

When the respective values for all the anions and cathions are determined, it will only be necessary to add together any particular pair, allowing for the concentration, in order to find the E.M.F. required for the decomposition of any solution, which is an important matter in technical electro-chemistry.

The following table shows the position of the break in the curve, on electrolysing solutions of different bases:—

| | | | |
|---|---|---|---|
| KOH ... ... ... | 1·00 normal | 1·40 volts |
| Na OH ... ... ... | 1·00 „ | 1·315 „ |
| Mg $(OH)_2$ ... ... | 0·0002 „ | 1·395 „ |
| Ca $(OH)_2$ ... ... | 0·02 „ | 1·33 „ |
| Ba $(OH)_2$ ... ... | 0·22 „ | 1·185 „ |
| Sr $(OH)_2$ ... ... | 0·063 „ | 1·20 „ |

Whilst the variation of the E.M.F. for different strengths of KOH was found to be—

| | | |
|---|---|---|
| KOH ... ... ... | 10 normal | 1·32 volts |
| „ ... ... ... | 4 „ | 1·38 „ |
| „ ... ... ... | 1 „ | 1·40 „ |
| „ ... ... ... | ½ „ | 1·45 „ |
| „ ... ... ... | $\frac{1}{50}$ „ | 1·47 „ |

This variation is not as great as it ought to be according to the theory, and the author points out that it may be due to the fact that what is measured may not be the point at which the potassium ions give up their charge, or, at any rate, that this point may be influenced if a potassium hydride is formed, which immediately decomposes into hydrogen, caustic potash, and platinum.

In conclusion, it is shown that, although the electrolysis of water can take place in a primary fashion, yet, as a matter of fact, especially if appreciable currents are employed, the decomposition is a secondary phenomenon.

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**Electric Organ.**—A Hope-Jones electric organ, which has been presented to St. Michael's Church, Chester Square, was opened, on Saturday afternoon, by Mr. Tertius Noble, organist of York Minster.

## THE PULVIS ACCUMULATOR.

Another storage battery is put forward in France as a competitor in the arena of traction. As the name indicates, the active material is originally an impalpable powder of lead. The support, in the case of the peroxide element, is a plate of lead, which has been subjected to hydraulic pressure; it is about one-third of an inch in thickness, and is closely grooved on each face, with a view to the retention of the peroxidised powder. The spongy lead support is of less thickness, and carries ribs of dovetail section, and about 160 mils apart. The dimensions and weight of the elements in the T-type cell are given in the following table:—

| | | |
|---|---|---|
| Number | of negative plates ... ... ... | 4 |
| | of positive plates ... ... ... | 3 |
| Containing vessel | length outside measure ... ... | 3·94 ins. |
| | breadth outside measure ... ... | 8·27 „ |
| | height outside measure ... ... | 9·84 „ |
| Plates | breadth .... ... ... ... ... | 7·58 „ |
| | height ... ... ... ... ... | 5·90 „ |
| | surface—both faces ... ... ... | 89 sq. ins. |
| | active surface exposed .. ... ... | 998 „ |
| | total positive surface in cell ... ... | 2,995 „ |
| Weights | positive plates ... ... ... ... | 5·6 lbs. |
| | negative plates terminal ... ... | 1·76 „ |
| | negative plates intermediate ... | 2·70 „ |
| | plates in cell ... ... ... ... | 25·76 „ |
| | plates, liquid and vessel ... ... | 35·20 „ |
| | total for 44 cells ... ... ... | 14 cwt. |

The rate of discharge, capacity, power, &c., are given as follows:—

| | | |
|---|---|---|
| Time of discharge ... ... ... ... ... ... | | 5 hours. |
| Rate of discharge in amperes | per sq. inch of exposed peroxide surface | ·01 |
| | per positive plate ... ... | 10·00 |
| | „ lb. of cell ... ... | ·85 |
| | „ cell ... ... ... | 13·6 |
| E.M.F. per cell. Volts... ... ... ... ... ... | | 1·95 |
| Normal power (watts) ... | per lb. of plate ... ... | 2·27 |
| | „ battery ... ... | 1·66 |
| | per cell ... ... ... | 58·5 |
| Specific capacity (ampere-hours) | per lb. of plate ... ... | 5·82 |
| | „ battery ... ... | 4·26 |
| | „ cell ... ... ... | 150· |
| Specific energy (watt-hours) | per lb. of plate ... ... | 11·36 |
| | „ battery ... ... | 8·3 |
| | „ cell ... ... ... | 292·5 |
| | „ 44 cells... ... ... | 12,870 |
| Energy in H.P.-hours for 44 cells ... ... ... ... | | 17·5 |
| Weight per kilowatt (lb.) | plates ... ... ... | 95·5 |
| | battery ... ... ... | 124· |
| Weight per kilowatt-hour (lb.) | plates ... ... ... | 18·2 |
| | battery ... ... ... | 24·82 |
| Weight per H.P.-hour (lb.) | plates ... ... ... | 13·6 |
| | battery ... ... ... | 18·27 |

The plates rest on two prisms of *ambroine*, a new insulating material made of fossilised resins, asbestos, and mica, finely ground, the mixture being subjected to a certain chemical treatment, and then moulded under pressure whilst hot. They are prevented from coming into contact by means of corrugated and perforated ebonite sheets. The containing vessels are of ambroine, and the lugs of the peroxide and spongy lead plates respectively are "burned" on to cylindrical omnibus bars of lead containing a core of copper wire.

It will be seen that, outside of the use of lead in powder—a material of somewhat questionable value—and of ambroine, this cell presents no novel features. The lead conductor, with a copper core, has been used experimentally in this country, and the corrugated and perforated ebonite sheets have been adopted by several manufacturers. The rate of discharge, and the density of current, above specified, are decidedly low, and a comparison with the cells mentioned in our issue of December 29th of last year (p. 925) will show that the capacity, though fairly high, is lower than that claimed by some other competing batteries.

## THE ECONOMY OF SUPERHEAT.

Writing in *Modern Machinery*, Mr. Geo. L. Robey endeavours to show that by means of superheating, the steam engine may at least be placed in a better position to compete with the gas engine. He shows the effect of superheating upon the bulk of steam in a cylinder, and lays weight upon this point perhaps more than he should do. We do not look to the thermo-dynamic effect of superheat in explaining its economy, but rather to its effect in counteracting the accident of cylinder condensation. In a truly adiabatic cylinder we should not expect a very serious economy from superheating, though Rankine calculated something over 20 per cent., we believe, in entire disregard of the peculiar action of the cylinder metal which, however, he did not recognise. To our mind the action of superheat is rather preventive. The great enemy to economy in the steam engine is the destruction of the initial steam by the comparatively cold cylinder metal. The cylinder is supposed to be cooled by its short period of communication with the condenser, but this is a very partial statement. True the communication with the condenser is a factor in the case, but a factor of no moment, save and except where the cylinder contains water. With water in the cylinder, a low pressure, and a cylinder with a temperature considerably above that corresponding to the pressure, any water present rapidly absorbs heat from the cylinder and passes off as steam with some 1,000 units of heat abstracted from the cylinder in the act of vapourising. If the cylinder contained only dry steam there would be only a small weight of this, and steam has a low specific heat, and in place of carrying off its thousand heat units per pound would only carry off at most about a third of a heat unit per pound per degree of temperature difference, and, moreover, dry steam would be a poor absorber of heat, which water is not. If, therefore, the cylinder be freed from water it cannot readily lose heat to the exhaust, and the beginning of the next stroke will find a cylinder still hot to receive the next charge of steam. If hot, the cylinder cannot abstract more heat from the steam, and there can be no initial condensation, and there can be no water to evaporate at the exhaust end of the stroke. Some engineers who consider that from 25 to 50 per cent. of the entering steam will be condensed are apt to give up the idea of superheating as hopeless, for they argue it will require so enormous a superheat to keep dry one half the steam. Now, as a fact, and speaking roughly, this large amount is only wanted for the first stroke to prevent the first charge of steam from liquefying. Subsequent charges will not liquefy because there was no liquid to re-evaporate and cool the cylinder during the first exhaust stroke. Nominally, then, if the cylinder be first heated to a temperature above that of the initial steam it would work all day without further superheat. Of course, in practice, the cylinder always does lose some heat to the exhaust, and there is always some water comes over from the boiler which would again start the vicious circle of re-evaporation and condensation. What, then, is needed in practice is a moderate superheat sufficient to provide for the amount of temperature which the cylinder will lose to the exhaust, and if this be given it follows the steam must be at least perfectly dry when admitted, it will supply the small additional heat to the cylinder metal to make up its loss, and will also supply such heat as disappears as work, or some of it. The heat which disappears as work in a hot cylinder probably only causes the working steam to become cloudy. It does not, we may probably assume with accuracy, cause a film of water to deposit on the cylinder. Then when the exhaust opens the cloudy steam sweeps out to the condenser and carries with it its water in suspension. This water, therefore, does not come in the way of any re-evaporative agency. It is thus clear, if our reasoning is correct, that with initially dry steam somewhat superheated, there is destroyed the power of the cylinder to produce its effects, and we doubt the desirableness of superheating beyond such amount as will produce a minimum of superheat in the exhaust. The effect of cylinder condensation is, of course, to admit more steam from the boiler for a given nominal cut-off, but such additional steam becomes water on its admission and only flashes back to steam as the piston moves forward and the pressure falls. With a given cut-off the same engine should be more powerful with saturated than with superheated steam, but the extra work is performed at a great expenditure of heat, and the large amount of water to be re-evaporated is not all evaporated during the working stroke. Much remains for the exhaust stroke during which the vacuum is more or less impaired by the additional steam

thus generated in the cylinder. Mr. Robey states that he has for two years worked an engine at such a temperature that Babbit metal remained melted upon it, and he had no trouble with it, no cutting or scoring. The sight-feed lubricator would not work, for its motive action had, of course, disappeared, but Mr. Robey believes in cylinders being lubricated by a pump. He had nothing but satisfaction with the working, and there seems to be little doubt to-day that a cast-iron cylinder will work well with superheated steam; indeed, with the gas engine before us, and the high temperatures which exist in this it can scarcely be doubted that the old trouble with superheated steam was practically a matter of animal and vegetable oils and fibrous packings. With mineral oils and metallic packing the difficulties disappear, and cast-iron seems to work up to a fine polished surface even with the most highly superheated steam, though, at the same time, we would never advise such excessive superheat as would manifest itself as superheat in the exhaust pipe unless, of course, such heat could be recovered by a feed coil interposed between the cylinder and condenser. There is no reason why this should not often be attempted, for as we point out above, it is, or should be, an exploded idea that the cylinder is cooled by proximity to a cold condenser. This is, of course, impossible; cold as such does not strike back and the cylinder is only cooled so far as it contains steam at the condenser pressure, and any water left in it evaporates at that pressure and tends to pull down the cylinder temperature to that of the condenser, say, 190° F. This idea of the frigorific effect of the condenser had much to do with the slowness with which the real action of the cylinder metal and wet steam became recognised. With so common a machine as the steam engine it is strange how little of its true action was explained to us by the professors and theorists. It remained for a more practical man, the late D. K. Clark, to point out the true action, and for Hirn to follow it up.

## ELECTRICAL HOUSE-WIRING REGULATIONS.

The three papers which were last night brought to the notice of the Institution of Electrical Engineers were all based on the same theme, namely, the want of uniformity in the regulations for house wiring issued by the authorities who claim a control of this work, and the authors of all three papers arrived more or less at the same conclusion, namely, that the time has come when the existing state of things should cease, and one set of rules should be generally adopted.

It is perhaps curious that the dissatisfaction expressed in these papers on the existing anomalies in wiring rules should not have been voiced before now, for all those who have had anything to do with wiring, and who can claim to have honestly endeavoured to conform to a high standard of work, have been for years suffering from the disabilities created by having to try to work up to (or down to) a different set of rules each time a house is wired; either because the district is supplied by another supply company, or because the house is insured by a different insurance company.

But the Englishman is long suffering, and will plod on in the same groove until one or other of two things happen; either someone helps him out of this groove without giving him any trouble, or else he helps himself out when he can stand it no longer.

In the case under discussion, a laudable attempt was made in 1897 on the part of the Council of the Institution of Electrical Engineers, to help the poor wiring contractor out of his difficulties by the issuing of a set of rules to be observed in house wiring, which it was presumed, and hoped, would ultimately supersede the hundred and one other sets of rules extant. But, as the authors of these papers have wisely pointed out, to issue a set of rules, and to enforce them, are two widely different kind of things, and under the present state of affairs there is unfortunately no more chance of their being enforced than are the edicts of the Tsung-li-Yamen to the Chinese people. The fire insurance companies and the electric supply companies are the mandarins, and until these parties have been "squared" in some way or other, there can be no uniform set of rules. All this may sound very hopeless, but do not let us be misunderstood; it is, as Mr. Wordingham, in his paper, points out, the *amour propre* of the different authorities which has to be considered, and this it is which will have to be "squared." It is, perhaps, customary to look upon the regulations issued by a fire insurance or an electric supply company as the creation, working out, and sole property, of the "company" *en bloc;* this is only a general and superficial view; in reality they are the invention of the particular individual who happens to have been appointed inspector of house wiring or station engineer, as the case may be, and of which he is no doubt, and perhaps with some reason, proud. We say "invention" advisedly, for no doubt owing to the nature of things there must be a certain amount of plagiarism—as the subject, being limited, and having once been dealt with—does not admit of much variation. On the other hand, it would not do for the individual who has just received an important and responsible post—and who is expected to get out a set of rules—to deliberately copy the rules of a rival concern; besides this, he no doubt has excellent ideas of his own as to the meaning of certain terms, such as "insulation resistance," and the value to be attached to them. And so it is but natural that, where there is an opportunity to make a variation, a variation is made, and each of these officials lives in a little world of his own, surrounded by his own particular set of rules.

All this is not intended as any reflection on those who have drawn up rules for the sake of distinguishing them from the rules drawn up by others; it is human nature to endeavour to excel, but praise may perhaps be withheld from all but those who were the pioneers of the subject, and those who are now endeavouring to put matters on a common basis, such as that suggested by the Council of the Institution of Electrical Engineers.

Perhaps the fact that wiring has gone on for so many years under this ever-increasing multiplicity of rules in a fairly satisfactory manner, may indicate that either the rules were not stringent enough, or the wiring contractor has been too honest, both of which suggestions may perhaps be disputed. It is a fact, though, that the exception proves the rule in the generality of cases, and although there are, and ever will be, "jerry wiremen," the bulk of this class of work done throughout the country may be said to be good. Of course, it is well known that rules cannot always be enforced, even by those who have the power to enforce them, as humanity will devise means of evading every form of law. It is not even necessary to be depraved in the manner that Mr. Pigg suggests in drawing false inferences from the bad wording of specifications; we have heard of such things as cutting the mains in a building before the inspector comes, obtaining a thoroughly good insulation test in his presence, taking him for a drink whilst "my men put the lamps in" (and joint the mains again), and then showing him the whole installation ablaze, so as to indicate that there is no break anywhere. We believe it is also not an uncommon thing, when the test is to be made, to send a foreman on to the job who knows the inspector, and who will "make it all right" with him.

However, these things happen in every trade, business, or profession, and will continue until mankind is so imbued with the desire to excel, that no laws or regulations will be required at all. In the meantime it behoves us to find some means to establish uniformity in these regulations; the method of enforcing them must be left to the authorities who claim to have a power to do so. Once let it be understood, however, by the wiring contractor that the insurance company and the electric supply company are working together, and not against each other; that he cannot play one off against the other; and that they both insist on having the same standard of work and the same tests; and the regulations will not need much enforcing.

In the papers we have before us, Mr. R. E. Crompton comes straight to the point at once, and advocates the adoption of the Institution Rules by all the interested parties. He suggests that where the Council stated "should be," the words "must be" should now be substituted. At the same time he is not forgetful of the other people who have drawn up rules, and although he points out that these had an oppor-

tunity to send in criticisms and remarks when the Institution Rules were only in draft form, he suggests that they should now be given another opportunity to come forward with a view to amending or supplementing these rules.

There is no doubt but that this is the correct way in which to approach the question as far as the rules themselves are concerned, but it must be remembered that the inspectors and engineers are not omnipotent in their companies, and it would seem to us that if the Council approached these companies through their secretaries and the boards, who would then instruct their officers to attend the conference and abide by the results, there would be much more chance of a uniform system of regulations being adopted and enforced. If the Institution Council could in the first instance obtain the assent and moral support of the Government through the medium of the Board of Trade, we think that the question would be still more easily solved.

The very complete paper brought forward by Mr. J. Pigg demonstrates that he has thoroughly mastered the anomalies of the various regulations extant, and he proceeds rather to criticise and pick these to pieces by setting them against each other, than to actually indicate how they may be made perfect. He leaves it rather to inference that the Rules of the Institution of Electrical Engineers should at any rate form a basis for the uniform set of rules to be adopted by concerted action; but he points out correctly that as these rules cannot be enforced now, the wiring as at present done is a result of the rules issued by the guarantors and the undertakers—(that is, insurance and supply companies)—and he proceeds to contrast these rules. His paper may be said to be a *reductio ad absurdum*, and there is perhaps no better way of pointing out the necessity for a new order of things than the adoption of this method of arguing. The two appendices constitute a valuable abstract of the "parish pump" spirit in which each separate company or municipality has been wont to draw up its rules, and in the first part of the paper Mr. Pigg draws attention to the fact that whereas each of the two parties concerned draws up a set of rules to protect their own interests, the supply companies invariably disclaim any responsibility for whatever may happen to the consumer or his premises through defects in the wiring, which is carried out under their own rules and inspection. This would almost seem to suggest to us that if the supply companies would confine their rules *entirely* to the test of insulation, resistance, and distribution of lamps (as, after all, the only things that concern them are leakage and load), and would leave the wiring rules *per se* to the insurance companies, who may be trusted to look after their own interests, the atmosphere would be considerably cleared, and one obstacle towards the realisation of the uniform and ideal set of rules would be removed. At any rate, the question is worthy of consideration, and we shall refer to it later on.

We cannot quite agree with Mr. Pigg in his remarks on the testing pressure to be employed. Although the actual pressure has no effect on the number of megohms of insulation resistance of the installation which determine the leakage current for the supply companies' consideration, still, in the interests of the insurance companies, some sort of breakdown test should be made. There can be partial faults in any system, which will only become apparent after a prolonged application of the working pressure; these may be badly made joints, bad contacts, or stray copper hairs inside lampholders. The application of a good rousing voltage would break these faults down at once, or indicate their existence, and subsequent inconvenience and risk to the consumer would be avoided.

The paper by Mr. C. H. Wordingham is by far the most interesting and to the point, more especially as the author is not only an eminent authority on the supply companies' side, but himself also assisted to frame the Institution rules. He therefore cannot be said to be unduly biased in either direction, and the spirit of moderation with which he approaches the subject amply demonstrates this. He acknowledges not only the conflicting interests at work, but also the many and great difficulties resulting therefrom to the wiring contractor, and he at once proceeds to differentiate between regulations necessary for safe wiring and those necessary to secure a satisfactory utilisation of the public supply of electrical energy.

He advocates the adoption of one general set of regulations for wiring to be of universal application, and he thinks that, as far as the public authorities' regulations are concerned, a model set of rules to be modified for every particular case or system of supply would be preferable to several standard sets of regulations. In this we are at one with him, as it has already been shown that too many regulations only cause confusion and defeat their own ends.

Now, Mr. Wordingham hits the right nail on the head when he points to the necessity for the proper supervision of fittings, in which should be included not only so-called "fittings," but switchboards, fuse boxes, and accessories of all sorts. Here lies the crux of the whole matter, and this, we think, is not sufficiently recognised. It is not so much in the actual *wiring* that the majority of faults are found, but in the connections behind switchboards, jointing and wiring inside fittings, the use of badly constructed switches and cut-outs, and the insufficient fusing of the system. As everyone who has had charge of installation work knows, the insulation resistance of the wiring alone, with ends properly freed, is generally too high to be measured with the usual instruments; but it is when the fittings are connected up that the insulation resistance falls, in almost geometrical progression with the addition of each extra lamp. There is not one-tenth the opportunity of causing risk of leakage, and consequently risk of fire, in the actual wiring work that there is in the fitting work. Barring accidents, such as abrasions to wire, driving nails through insulation, &c., all of which can easily be avoided (to say nothing of making careless joints), the whole of the wiring work and its efficiency is in the hands of the wiring contractor, and he may be said to be responsible for everything. But when the question of fittings is considered, the wiring contractor is only responsible at present for the proper connection of these to his mains, and for their efficient insulation from earth. If the fitting can be easily wired, he does this also, but if it is a complicated fitting, it is usually wired by the fitting maker; and although the wiring contractor is supposed to see that the wiring of the fitting is properly insulated from "body," even if he does this it is not often that he will or can take the trouble to examine the actual wiring himself. He also takes the word of the fitting maker that the ceiling roses, plugs, cut-outs, &c., which he buys are suitable for the purpose he has in view, and one of the last things he would think of would be to test across the contacts of a plug, or to determine the insulation resistance of a slate slab. Yet it is these things which are every whit as important in determining the leakage as the connection of the wires to the fittings, and so the responsibility for leakage due to the fittings may be said to be equally divided between the wiring contractor and the fittings maker. But here comes the difficulty: how to bring home this responsibility to either, for it is evident and only natural that each would refuse to accept any responsibility for work done by the other.

Mr. Wordingham draws attention to the system recently instituted in Manchester by himself for the testing and registration of fittings; and we only regret that he has so modestly refrained from publishing further particulars and details regarding it. A good many people consider that a system of this sort will do more to consolidate the question of wiring rules and to bring the wiring trade into better repute than any set of rules which could be issued. We have from time to time in our columns drawn attention to the bad construction and wiring of fittings, the insufficient fuse control of installations, and the cause of low insulation tests due to faulty switches, cut-outs and fuseboards, and considering this it is probably remarkable that, with the multitude of electric supply companies, municipalities, fire insurance companies, and scientific societies in existence, no attempt should have been made, until just recently in Manchester, to control the design of fittings and fixings. It may be, as Mr. Wordingham says, that makers of repute would be only too anxious to obtain certificates for their goods, as these articles would then have the hall mark of approval of the authorities to the disadvantage of the cheap and badly designed fittings which are not only imported from abroad, but, it is sad to relate, are also made here.

But Mr. Wordingham recognises that the matter, if pushed further, and adopted generally, cannot rest where he has started it.

If every authority who issued rules for wiring also adopted a system of registration for fittings, the complication and

confusion would be worse than anything yet experienced with wiring rules; for we should come to this pass, that fittings which were allowed on one side of the street would be tabooed on the other side, and makers who had stock patterns would stock each branch with the particular articles which were allowed in that district or town. It is evident, then, that if we are to have the registration of electric light fittings as a whole—this work should be undertaken by some central authority, whose certificate shall not only give the hall mark of approval but of the law. It is the only way to put the matter on a satisfactory and sound basis.

To whom, then, shall this authority be assigned? Mr. Wordingham thinks that the Board of Trade is probably out of the question; but why? No doubt there are great objections to Government control, with its reputation for red tape and inertia. But if not the Government, then who? The County Councils could not be considered for a moment, as they are as many as the supply companies. Mr. Wordingham suggests the Institution of Electrical Engineers; but any certificate given by this body would under present conditions have about the same value as the rules which they have issued, and the use of the fittings which they would register could not be enforced. Apart from that, no better body could be found than the Institution to regulate and enforce a proper system of electrical installation work for the mutual benefit of the consumer, the guarantor, and the undertaker; in other words, for the public generally.

The subject is now narrowing itself down to a definite policy. Leaving the consumer—or, let us say, the public—out of the question for the moment, we have three parties to consider, namely, the guarantors (with whom may be associated the large body of consulting engineers), the undertakers, and the central authority—say, the Institution of Electrical Engineers. Now, this body contains, besides the professorial element with which its name always seems to be dimly associated, a large and influential number of commercial and practical men. Why, therefore, should not a committee of these gentlemen be constituted on the same lines as the general committee, without powers to regulate the administrative and scientific proceedings of the Institution, but with authority to control the proceedings of the trade and the profession generally; to issue regulations in consultation with all the authorities concerned; to have a laboratory for the registration of fittings of every sort; and if necessary, to act as a medium for the interchange of trade information; in fact, to be a sort of electrical chamber of commerce and guild combined, which would be supported and endowed by all firms of repute and other bodies interested in the electrical industry. If the association of a body with such a worldly and commercial progamme did not commend itself to the scientific proclivities of the Institution, then there is no necessity for the two bodies to be under the same roof, or even included in the same title.

The next question is, to which of these parties should the enforcement of the various duties or regulations be assigned? We have also three of these, namely, wiring regulations, supply regulations, and registration of fittings. Our proposal is that the central authority shall constitute a committee of all three parties, namely, fire insurance inspectors, supply engineers, and practical members of its own body—for the drawing up and permanent consideration of rules for wiring, for supply, and for registration of fittings. These rules would then be issued and carried into effect under the ægis of the central authority, and the inspection and duties would be carried out by the parties whom the particular work concerned. That is, the fire insurance inspector (or the consulting engineer or consumer) would see to the due carrying out of all work under the wiring rules, which would also include the fixing of fittings. The electric supply authorities would, as before, appoint their inspectors to make tests at the inauguration of an installation and also from time to time subsequently; they would likewise see that the rules for balancing and switching on of loads were properly adhered to. And the central authority would entirely control the inspection, testing, and regulation of all fittings and fixings.

We finally come to the most important point of all: How is all this to be enforced? There is only one reply to this question, namely, by Parliamentary powers.

The Electric Lighting Acts need not necessarily be amended for this purpose, but—as Mr. Wordingham suggests with regard to the enforcement of wiring rules only—a special Act could be obtained, giving the necessary power to the central authority to make the regulations and to enforce them in the same way that the railway companies enforce their bye-laws.

We have, perhaps, said enough to indicate the general outlines of a scheme for putting the installation business on a sound and permanent basis. That there has been a feeling abroad for a long time that something should be done we all know, and the electrical world is therefore indebted to these gentlemen who have simultaneously raised the cry of "How long?" in their papers to which we have referred, and to whom we are under an obligation for many valuable ideas, and the opportunity to be able to raise this question in the press.

Let us therefore hope that the discussion to which these papers give rise will tend to a more general appreciation of the unsatisfactory state of things as they now are, and that this feeling will stimulate action, so that the electrical installation business may inaugurate the 20th century by setting its house in order.

## MUNICIPAL ENTERPRISE.

ALTHOUGH the various local authorities of the United Kingdom are, as a whole, to be congratulated on their foresight in obtaining provisional orders for electric lighting, and erecting electricity works, yet there are instances in which, after the expenditure of several years of profound deliberation, the "City Fathers" appear to have fallen an easy prey to the ubiquitous company promoter, and have, with more precipitation than prudence, delivered over their provisional orders on terms opposed to the interests of the community they are elected to represent.

A somewhat curious case has recently occurred in a Lancashire town of about 15,000 inhabitants, which calls for some comment.

In 1896 an electric lighting company sought permission to include this district in a provisional order which it was promoting.

The Council with commendable promptitude obtained a report on the matter from a well-known consultant, and on his advice passed a resolution to erect electricity works in conjunction with a refuse destructor at a cost of some £25,000. A provisional order was obtained in 1897, and a Local Government Board inquiry was held last August, in the course of which considerable opposition was roused, owing to the site for the works being partly surrounded by villa residences. Other sites were, however, available though not so central, and therefore not so suitable viewed from an engineering standpoint.

The authorities at Whitehall having considered the matter, requested the Council to choose another site further removed from a residential neighbourhood. This appears to have completely disheartened the local gods, who have now passed a resolution disposing of their provisional order to a company (who will, of course, have to find a site), for the full term of 42 years, with the right of purchase after 21 years at a premium of *21 per cent.* According to a local daily contemporary this company undertakes to erect combined works and supply current in nine months' time, to destroy refuse at 9d. per ton, to charge 5d. per unit for private lighting and 3d. per unit for street lighting.

It may be of service to other misguided and benighted Councils to consider this extremely one-sided deal.

The Council will have a business built up for them, without having to make good a possible deficit on the working of the undertaking for the first few years. They will then naturally want to buy out the company, but this they cannot do till the end—not of 7, 10, or 14 years—but 21 years, when they will have to give a sum which would have met any loss during the opening years of the works many times over. What is the experience of other local authorities where electricity works were started by companies, and which,

in some cases, were running at a loss, small towns too, such as Taunton, Bray, Fareham, Morecambe, Shrewsbury, &c.? Why, the works have been bought up and are all on the high road to success.

Assume that the company has, at the end of 21 years, expended a sum of, say, £100,000 on the works, and this is no unreasonable figure, for the district is at present somewhat sparsely populated, and lies on the borders of the Metropolis of the North. The Council, if they wish to purchase, must pay the market value of the undertaking, say, at least £110,000 plus £23,100—21 per cent. premium—making a total of £133,100. What do the ratepayers gain for this £23,100? Absolutely nothing which would not have been theirs had they insisted upon the adoption of a municipal electric supply scheme, and they lose in addition the profits which will, without question, be made on the works after they are fairly started. The longer the purchase of the works is delayed the greater will be the loss.

Again, if the company could be bought out in, say, seven or ten years at a cost of £25,000, plus 21 per cent. (£5,250), would not this latter sum, if paid in annual instalments, have more than covered any initial deficit? The answer is obvious.

Turning to the engineering side of this undertaking—the town is somewhat scattered and an alternating system was recommended. Two-phase generators could, however, have been installed with advantage to allow of motors being used in manufacturing works near the docks.

Reverting to destructors, in a large electricity works their room, for various reasons, is to be preferred to their company, but in smaller installations, especially those equipped with alternating plant, they may be of considerable service.

In this case the destructor could be relied on to supply sufficient steam to run, say, a 30-kw. machine throughout the 24 hours. This would not only supply all current required during the day, or reduce the coal bill if many motors were connected to the mains, but it would also probably generate sufficient current to run incandescent street lamps during the evening.

The question of nuisance arising from the working of a small destructor plant, unless in an extremely confined situation, is a bogey. There is no doubt that the leading makers of these necessary evils would have accepted any number of clauses binding them down to commit no nuisance—with their plant. Indeed, if they *accept* and *work* to the specifications we have sometimes perused, they will indubitably prove themselves equal to anything.

Further comment on the action of these local Esaus is superfluous; they have probably sacrificed their electrical birthright for a mess of pottage, proving once again that in a multitude of "Counsellors" there is not always wisdom. They would be well advised even at this eleventh hour to reconsider the matter. The recession of such an important motion would cause the electrical industry no surprise. It has taken place before—but that is another story.

## CORRESPONDENCE.

### Notes on Three-Phase and Tramway Work.

I notice in the ELECTRICAL REVIEW for January 20th the "Notes on Three-Phase and Tramway Work," by Mr. A. Gibson.

I think there can be no doubt as to what was taking place when generator B was working in parallel with the generator A, the former being driven by the Pelton wheel without a governor and the full amount of water being admitted, the latter driven by the direct coupled induction motor, M, receiving its current from the mains through the transformer T.

The speed of M and A was necessarily limited to the speed corresponding to the no-load revolutions of the induction motor at the given number of cycles, whereas B was inclined to race, and, therefore, would always take the greater part of the tram load. It would, in fact, take so much load as to reduce its useful volts to those of generator A; if more load was to be negotiated it would now probably all fall to generator A, as its speed would only vary very slightly, whereas B would fall off in speed much quicker if the load on it came to be increased.

The variation of speed with varying loads being infinitely less for an induction motor than for a Pelton wheel without a governor.

Suppose, now, that the tramway load required less than the full power of the Pelton wheel, this latter would race to a certain extent, and the useful volts of B would be higher than those of A. A would now be driven in the ordinary way as a motor, and would increase its speed to slightly over that number of revolutions which would correspond to the synchronous speed of the induction motor, M.

It would be checked very soon, however, as M would now work as generator, and take a proportion of the load on the three-phase side, this proportion being determined by the amount of power still available behind B. Should there happen to be no work to be done on the three-phase side the whole plant would race.

The induction motor depends for its torque on the current induced in its short circuited portion and due to the "slip," which causes the short circuited circuits to cut the main field.

If, therefore, this short circuited portion, usually revolving and called rotor, is driven at a speed exceeding that of the main field, it will still have a current generated in its circuits again due to a relative movement or "slip." But, if this slip was negative in the first instance it will be positive now, though the actual direction of rotation has remained the same.

The motor now works as generator, the currents in the "rotor" producing an electromotive force in the main windings which, together with the E.M.F. of self-induction, go to make up the useful terminal E.M.F.

It will now be seen that such a motor can only work as generator as long as the main field is provided. The main field is provided in this case by the synchronous generator not shown on the figure.

It is, further, also clear that by inserting a resistance in the rotor the currents therein are greatly reduced and do not produce the necessary E.M.F. in the main windings. It is equivalent to reducing the excitation on a synchronous generator.

When M is working as a generator it is possible to shut off the driving power of the main generator (not shown), and provided its direct current excitation is kept on, the whole of the plant will continue to run, the total work now being undertaken by M, the power coming from the Pelton wheel through B and A.

The synchronous generator decides the period of the system.

Some seven years ago Messrs. Siemens & Halske patented such a combination of a synchronous with non-synchronous generators in order to obviate the necessity of any precautions when parelleling. Other leading Continental firms have at about that time made similar experiments, but I am not aware that any practical use has been made of these very interesting discoveries. The reason seems to lie in the inefficiency of such an arrangement and due to the inherent qualities, or, rather, defects, of the non-synchronous motors. The phase relation between E.M.F. and current is at best a distressing one. It also varies greatly with the load, so that I am not surprised to see that the amperemeter in the case referred to by Mr. Gibson varied so little. A good wattmeter could alone give reliable results in such a case.

The ideal mode of paralleling proposed by Messrs. Siemens and Halske, though extremely interesting, will probably never be used unless an induction motor is put on the market with a power factor = 1 for all loads.

Trusting these remarks may prove of interest to you.

Val. A. Fynn.

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In the current edition of your paper I notice some remarks by Mr. A. Gibson *re* the above.

I offer the following, which seems to clear it up—to my mind, at any rate.

Everyone knows that any alternating induction motor will deliver power back to its mains if driven at a speed somewhat greater than that corresponding to synchronism. All that is necessary, then, is for the 550-volt generator (marked A) to be driven as a motor by the 600-volt set (marked B).

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Provided that A is a shunt or compound with few series coils, its direction of rotation would be the same as before; and as the voltage at its terminals would be greater than 550, its speed would likewise be greater—satisfying the above requirements.

If a compound machine, its speed would be greater still, due to the weakening effect of the series coil.

M. J. O.

### Proposed Wireless Telegraph and Electrical Traction Systems.

I have read your criticisms upon my two letters appearing in your issues of the 13th and 20th inst., and I absolutely fail to see any reason why you should characterise my proposed international wireless telegraph system as of the "wild cat genus." No less an authority than Prof. S. Thompson has asserted that it is quite within the range of practicality to telegraph wirelessly across the Atlantic, and I daresay Mr. W. H. Preece, of the Post Office, is of the same opinion, yet when I inform you that I propose to connect up Great Britain with America, Africa, Australia by wireless telegraph, you, in your haste, are as good as saying it is impracticable. All I can say is that your faith in the future of wireless telegraphy is *nil*. Certain it is that before we can get a popular 2d. or 3d. international or universal word rate the wireless telegraph will have to supercede the submarine cable. It all amounts to a suitable transmitter and receiver, and I claim I have successfully solved that part of the problem, and ere 18 months hence you will have an opportunity of seeing it at work between Cornwall and Halifax (Canada). As to the electrical traction system which I propose to introduce shortly, you will, among many others, have an opportunity of seeing an electric tramcar equipped with my new method of propulsion running on one of the tramlines in England on some Sunday in next summer or autumn, and in common justice I must ask you to possess your soul in patience until you have seen the above, when you will then be in a position to criticise it, and not before. At any rate, it will be time enough for you to apply the term "wild cat" to my invention when you write up your review of electrical progress for the year 1899 after many of them have appeared. Thanking you for the publication of above.

Geo. H. Smith.

37, Daniel Street, Cardiff.
*January 23rd.*

### "Cyclist" and "Pertinax."

It is the fate of everyone who publishes a book or an article to be criticised.

If the remarks I made in my letters signed "Cyclist" on the electrolytic treatment of ores and on the use of the word cycle were not justified, Mr. Cowper-Coles was at liberty to refute them, but he has not done so.

In the "Pertinax" letter I objected to an article signed by Mr. Cowper-Coles which was not genuine.

Mr. Cowper-Coles says that he knows the faces of those who lurk under anony(mos)ity. He ought to know that I have no animosity against him, and that I did not grudge him the praises he deserved for his successful deposition of zinc.

As an electro-chemist Mr. Cowper-Coles has rendered some real services for which he deserves our thanks, and everybody renders him justice for his indomitable energy and skilful work; he must however, not be offended if I frankly tell him that the articles he writes do not please me as much as those which by electro-deposition he coats with zinc or other metal.

E. Andreoli.

### London County Council.—Victoria Embankment Electric Lighting.

Manufacturers and contractors have, no doubt, obtained copies of the above specification and examined its provisions.

I cannot believe that, after doing so, any responsible firm with the experience of the past before them will be found willing to tender on its terms.

The specification provides *inter alia:*

(*a*) The usual dictation under heavy penalty as to wages and conditions of employment of all labour employed by the contractor *and every sub-contractor from whom he may obtain labour or materials.*

(*b*) Completion in six months (this exhibits foresight on the part of the L.C.C., having regard to the crowded condition of the industry and the inability of manufacturers at the present time to make early delivery) subject to—

(*c*) A penalty of £50 per week (on a contract of under £1,500 total value).

(*d*) The Council may fight or settle any legal proceedings arising out of the works, without consulting the contractor, who will, however, have the privilege of paying the bill.

(*e*) The L.C.C. engineer to be sole arbitrator of any dispute.

Men and opinions change, and representative experts of superior experience and qualifications to the officers of the L.C.C. have agreed in regarding such conditions as anachronisms belonging to a bygone age. But the Council goes its own way in defiance of custom and usage, blindly trusting to bend the commercial traditions of the people to its will.

It is to be hoped that electrical contractors will resist this attempt to deprive them of the advantages of the improved conditions which they have secured elsewhere.

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London, *January 23rd*, 1899.

## LONDON COUNTY COUNCIL.

On the resumption of business on Tuesday, the Finance Committee reported to the County Council that the Islington Vestry had declined to take up, on the terms required, the loan of £6,780 agreed to be advanced by the Council last November. The new Vestry asked for formal sanction to the borrowing of the money, and on the recommendation of the Finance Committee, it was resolved to give the permission required, the rate of interest not to exceed £3 2s. 6d. per cent.

#### Central London Railway.

The engineer of the Central London Railway Company had submitted to the Highways Committee a detailed plan, showing the proposed construction at the street level of the Queen's Road Station. A general plan of this station was approved three years ago, and the company now propose to provide only one staircase to the street level instead of two, as originally projected. The Committee expressed the opinion that this arrangement would not be likely to cause inconvenience, as in addition to the staircase there would be three lifts for passengers; and the committee had been informed that the means of access to and from the City and South London Railway, where single staircases and lifts existed, had been found quite sufficient. The Highways Committee accordingly recommended that the Council should approve the amended plan, but the consideration of the question was postponed.

#### The Telephone Question.

Mr. J. W. Benn, chairman of the Highways Committee, obtained permission to withdraw for four weeks the adjourned report of the committee proposing to sanction the continuance for periods of from 6 to 12 months of the long-span overhead wires erected by the National Telephone Company in Islington. He stated in explanation that the local authority had taken action, and that the committee did not desire in any way to hamper the Vestry in the matter.

Colonel Ford asked whether the chairman of the Highways Committee had made himself acquainted with the proposals contained in the Bills promoted by the National Telephone Company, intended to confer a practical monopoly upon the company. The speaker drew attention to the notice of motion standing in his name on the subject. The chairman of the Highways Committee stated, in reply, that he had read the notice of motion, and that he believed it had also received the attention of the company.

The notice of motion referred to was postponed to a future meeting. It is as follows:—"That in face of the application recently made by the Council to Her Majesty's Postmaster-General with a view to a London municipal telephone service, and in face of the report of the Committee of the House of Commons last session, this Council views with grave concern the aims of the National Telephone Company as contained in its Bills now before Parliament, and accordingly refers it to the Parliamentary Committee to consider, after conference with the Highways Committee, the desirability of petitioning against the said Bills, which appear to aim at a grosser and perpetual form of monopoly than that already enjoyed by the company, to the serious injury of the trade and business of the metropolis, which monopoly already deprives the ratepayers of London of a legitimate source of public revenue."

#### Proposed New Works.

The Building Act Committee recommended and it was decided to disapprove the plans submitted by Mr. F. Forbes Glennie, on behalf of the Blackheath and Greenwich District Electric Light Company, for the construction of a generating station on the north-west side of Blackwall Lane, East Greenwich. The refusal was based upon the

opinion of the committee that it was undesirable to sanction the erection of a wood and iron temporary enclosure to any part of the building, the proposed construction of which was, moreover, considered to be unsatisfactory in several respects.

It was announced by the Building Act Committee that they had declined to consent to the erection at the works of the Western Electric Company, North Woolwich, of an addition to the works, such addition and works together exceeding in extent 250,000 but not 450,000 cubic feet, and to be used for the purpose of manufacturing cables of large diameter. The reason for refusal given by the committee was that it had not been shown that the additional cubical extent was necessary for the purpose of the trade carried on at the premises, or that proper arrangements had been or would be made and maintained for lessening danger from fire, and that no reason was seen why the rules of the Act should not be strictly observed in this case.

### Fire Alarms and Telephones.

The Council were reminded by the Fire Brigade Committee that a system of telephonic communication exists between certain police stations and fire brigade stations. The chief officer had suggested to the Committee that as each sub-divisional police station was in electrical communication with a police superintendent's station, telephonic communication should be established between each divisional superintendent's station and the nearest superintendent's station of the Fire Brigade. As the adoption of the proposal would increase the number of points from which information of fires could be promptly transmitted to the brigade. The Committee had approved of the suggestion. The Post Office authorities were prepared to provide and maintain the 20 lines of communication required on payment of an annual sum of £377 under a three years' lease, and at the suggestion of the Committee the Council sanctioned an expenditure for this purpose.

### The Greenwich Company's Appeal.

The Highways Committee reported that last October the Council sanctioned the works referred to in a notice of the Blackheath and Greenwich District Electric Light Company, with the exception of the laying of mains along Deptford Bridge, which part of the works were formally disapproved. The company appealed to the Board of Trade against this disapproval; and at the hearing of the appeal on January 12th, the Council's solicitor drew the attention of the Board's inspector to section 81 of the company's order which provides "that nothing in the order shall authorise the undertakers . . . to interfere with or make use of any county bridge . . . . vested in the Council, except with the consent in writing of the Council;" and the inspector was, further, informed that the Council's consent to the laying of the mains along Deptford Bridge had never been obtained or even applied for under that section, which, moreover, did not confer upon the company any right of appeal. The inspector decided that the objection raised was fatal, and that, therefore, the appeal could not be proceeded with.

## THE TELEPHONE SYSTEM.

The *Times* of the 20th, 23rd, and 24th inst. contained articles entitled

### THE TELEPHONE SERVICE.

### The Case of the National Telephone Company,

*(From a Correspondent)*,

of which the following is a summary:—

The first article relates the story of the initiation and early struggles of the enterprise from 1877 to 1892; the second, the history of the development of the service from 1892 to 1898; and the third, the story of the latest departure in Government policy, with comments and observations. In the view of the *Times* "correspondent," "the history of the telephone service in this country discloses one of the most remarkable instances in modern times of Government ineptitude and blundering, and may be summed up in five words—'How not to do it.'" The Government had the opportunity of acquiring the telephone patents and failed to do so. Companies were formed and commenced business, whereupon the Post Office asserted their rights to monopoly and had them sustained, subsequently issuing licenses which have been varied in their scope and were held by different companies, the principal ones being the United Telephone Company, the National Telephone Company, and the Lancashire and Cheshire Telephone Company.

As soon as these companies had been thoroughly established it became clear that ultimate success was only to be obtained by uniformity of system, similarity of method, concentration of administration and management, and complete intercommunication between all subscribers, and the outcome was that these three companies amalgamated on May 1st, 1889, and became the National Telephone Company, which soon found that it was essential to complete the consolidation, and to purchase the smaller subsidiary companies operating in the remaining parts of the United Kingdom.

One of the first results of amalgamation and concentration (and it must be remembered that none of the amalgamated companies were in competition with each other) was a material reduction in charges.

It has been asserted that the capital of the company has been largely watered, but it is explained that the amalgamations were effected on the basis of market values, and whilst the valuation was £4,565,027, the actual construction cost was £3,284,259, leaving £1,280,768 to represent the market value and goodwill as going concerns of the various amalgamated companies.

During the early development of the enterprise, the writer states, the Post Office used its best endeavours to restrict and to harass the services of the companies, with the object—laudable in its way, but quite mistaken—of protecting and safeguarding the revenue from the telegraphs, but in 1892 the Government declared its intention to make a new departure in policy by purchasing the trunk lines, and by again confining the companies to specified areas. The Government submitted to Parliament a Treasury minute setting forth their proposals "for the further development of the telephone system in the United Kingdom."

It is held that the position which the company then occupied was unassailable by competition, as its system was established in all the principal towns of the country, joined together by a network of trunk wires, and thus no effective competition was practicable.

The company was invited to surrender this position of strength, to place itself largely in the hands of the Government, and to rely upon the Government's carrying out the policy set forth in the Treasury minute in honour and in good faith.

The company naturally required the fullest explanations, which were freely given by the responsible Ministers and officials, and the directors were assured that the object and intention of the Government was to assist and co-operate with the company, to afford every reasonable facility for doing its work, and to bring the system of the company into conjunction with that of the Post Office. Relying upon the assurances received and believing that the Government was pledged to carry out the policy indicated, the company agreed to sell its trunk wires, and from 1892 to 1898 the Government gave full effect to its assurances and pledges, and carried out the policy set forth in the Treasury minute according to its spirit and intention, but in April last in the House of Commons' debate, Mr. Hanbury indicated an intention on the part of the Government to vary the policy of co-operation with the company, which was the essence of the Treasury minute of 1892. In the course of his remarks, Mr. Hanbury said that the company's plant and system could be replaced for a little over £2,000,000, whilst it is stated that the company has expended, in cash on its system, upwards of £5,000,000, of which £2,500,000 has been spent since 1892, on the faith of the arrangements concluded with the Government, and with respect to which Mr. Preece stated before the Committee of 1895 that the company was employing the best materials, was doing its work in a way of which he approved, and that if the Post Office took over the system in 1911, it would (if the company continued to do as they were doing) have a first-rate system with first-class materials and telephones. The further Parliamentary Committee promised was in due course appointed, and notwithstanding the evidence given by the official representatives of the Post Office and the company as to the spirit and intention of the arrangements of 1892, involving co-operation between the Post Office and the company, reported in favour of active competition, of refusing reasonable concessions. Acting presumably in the light of this report, the Post Office has already commenced to harass and impede the operations of the company. It is urged that the report of Mr. Hanbury's committee is apparently based upon the theory that the true policy and interest of the State during the remaining years of the company's license, is to endeavour, by setting up competition and by harassing and impeding the company, to as much as possible minimise and break down the company's system. The committee, in adopting this theory, has, however, forgotten three things.

First, the waste of capital involved in the State, municipalities, and the company each laying down competing systems, which ultimately will have to be brought into conjunction and harmony at further cost.

Second, the inconvenience to the public in having competing systems, which involve all the more important subscribers having to join and pay for two or more systems; and,

Third, the breach of faith towards the company involved in any departure from the policy laid down in the Treasury minute of 1892, on the faith of which the company sold its trunk wires, and raised and expended additional capital.

It is urged that there are only two solutions of the question possible: to relieve the company from all the present impediments which restrict it from adequately developing the service and give it a free hand, subject to Government control, or for the Government to acquire the remainder of the company's undertaking and work the whole service as part of the business of the State. The Government had no difficulty in making its bargain with the company for the acquisition of the trunk wires, and there is no reason to suppose that it would have any greater difficulty in dealing with the company for the acquisition of the remaining part of the undertaking.

After summarising what are alleged to be the six "mistakes of the Post Office in relation to the telephone question," the articles conclude with a reference to the absence of proper powers, its limited tenure, and most serious difficulties and impediments, finally remarking that the company is conducting a public service—the growth of barely 20 years—which in volume of business is more than five times greater than the postal telegraph service of the State, and the wonder is, not that it has done so little, but that, under all the circumstances, it has done so much—although, if existing impediments were removed, much more might be accomplished.

**Electrical Appliances Exhibition.**—Mr. H. Greville Montgomery asks us to announce that he is holding a special exhibition of electrical appliances in connection with the biennial Building Trades Exhibition to be held at the Royal Agricultural Hall from April 26th to May 6th next. The minor hall will be given over entirely to this purpose, the whole of the ground floor and galleries of the great hall being already let. It is thought that this is a very good opportunity for bringing electrical engineers and manufacturers in touch with the building interests.

## BUSINESS NOTICES, &c.

**Announcement.**—Mr. W. J. Davy informs us that he has finally severed his connection with the Davy Electrical Construction Company, Limited.

**Annual Dinner.**—On Saturday the staffs of the London and Belvedere offices of Messrs. Callender's Cable and Construction Company, Limited, held their first annual dinner and social evening at the Bridge House Hotel, London Bridge. Mr. Manning, secretary of the company, presided. The usual toasts and a very varied musical programme followed the dinner.

**Books Received.**—"Continuous Current Dynamos in Theory and Practice," by J. Fischer-Hinnen. Biggs & Co., Salisbury Court, 10s. 6d.

"The Law of Tramways and Light Railways," by Seward Brice, M.A., LL.D. London: Stevens & Haynes.

**Brazilian Rubber.**—*Commerce* quotes the following from a report on the industries of Pará and district, by the British Consul there:—"The northern tributaries of the Amazons do not produce much rubber. Of these, the river Negro produces the most. The quality, however, is soft. The river Branco yields very little rubber, and the upper part runs through pasture lands and high ground, which is not suitable for good rubber. Some of the other northern tributaries have not been explored, and may yet reveal large stores of rubber. The "hevea" is known to exist on the banks of the Japurá, but that district has not yet been opened up. The following articles are used in the India-rubber industry: A clay funnel, which in shape is very much like an ordinary toilet water jug without a bottom or handle. It is made of the clay that exists in most parts of the Amazons. The fuel used in the funnel consists generally of the nuts of palms. It was at one time imagined that the excellence of Pará rubber was greatly due to this kind of fuel used in curing it. The palms that furnish this fuel were accordingly transplanted to Africa with a view to making Pará rubber there. The experiment, however, has not succeeded. The reason why these nuts are selected in Brazil is because they emit a continuous dense smoke, and are more portable than other fuel obtainable. However, when none of the palms named are present, then bark and twigs are used as fuel. Every man engaged in the forest carries a wood-knife. One of its uses is to cut down fuel for the preparation of rubber. The blade is about 26 inches in length and about 2 inches broad. All the knives are imported from the United States and Germany. These countries vie with one another in selling a serviceable article as attractive and cheap as possible. Owing to the damp climate the blades are electro-plated; this prevents them from getting rusty before they are sold. The handles are made of wood and are carved or inlaid with brass."

**Changes of Address.**—The Royal Meteorological Society has removed to Princes Mansions, 70, Victoria Street, S.W.

From the 2nd inst. the address of the Institution of Mechanical Engineers has been changed to Storey's Gate, St. James's Park, Westminster, S.W.

Messrs. "Holophane," Limited, have removed their offices to Wardrobe Chambers, 146A, Queen Victoria Street, E.C. Messrs. Falk, Stadelmann & Co., of Veritas Works, Farringdon Road, E.C., will keep a stock of the globes for oil and gas lighting; the General Electric Company, of Queen Victoria Street, keeping a stock of the electrical patterns and fittings.

**De Laval Turbines.**—We learn that the De Laval Steam Turbine Company, of Stockholm, has secured an order for 16 steam turbines for the Austrian Navy to be used in running dynamos for lighting purposes.

**Dissolution of Partnership.**—Messrs. J. Drury, F. Drury, and J. F. Drury (Drury Bros., musical and electric bell founders, &c., Stock Orchard Street, Holloway, N.) have dissolved partnership. Messrs. J. and J. F. Drury will attend to debts and will carry on the business under the old style.

**"Ediswan" Night Light Switch.**—The Edison and Swan Company are making a night light switch (Captain Walters' patent), by the use of which the electric light as a night illuminant may be taken the fullest advantage of. The object is that when the ceiling light or principal lamp is turned out by switching off, a smaller lamp enclosed in the night light can be, or is, switched on, thus serving not only as a night light, but showing the position of the switch in the room. Hitherto it has been found impracticable to reduce the intensity of the principal light economically, but the employment of the smaller lamp adapted in this switch is claimed to dispense with this objection, and only the proportion of current is burned that is required for the light, which is equal to 2½ candle-power, or one-fifth the nominal current of a 16 candle-power lamp.

**The Electrical Cab Company pays Compensation.**—One of the cabs of the London Electrical Cab Company ran into a coster's barrow laden with fruit, knocking down the horse, breaking the harness, and injuring the barrow and stock, also doing personal injuries to two costermongers named Gear and Miller. At the Wandsworth County Court on 23rd inst., Judge Lushington awarded £110 compensation to Miller and £45 to Gear.

**Electrical News from the River Plate.**—The following interesting items regarding the progress of electrical work in that part of the world, are taken from the *Review of the River Plate*:—The German Electric Light Company having continued to lay its mains in the manner for which it was ordered a 10 days' suspension of the work, on account of the damage done to the trees in certain streets, a heavy fine has been imposed, and some of the mains have been pulled up by the authorities.—Mr. W. R. Cassels will retire from the managing directorship of the River Plate Electric Light and Traction Company, Limited, at the end of the current year, Mr. Cassels is the pioneer of electric lighting in this country, and has had very uphill work. In 1888 he turned his business, comprising La Plata and other concessions, into a company, with which he has held the post of managing director ever since. From La Plata the company has grown to such an extent that it now has large stations in Buenos Ayres, Rosario, and Tucuman. Mr. Frank Cassels, the technical director to the company, has been appointed to succeed his brother in the managership.—The City Council, after a lengthy and heated discussion, has given the Metropolitana tramway permission to change over to electric traction. We congratulate the company on being freed from the obligation of lighting the districts through which its line runs, a concession the other electric tramways have not been so fortunate as to secure. Truly the German company, by which the Metropolitana tramway is owned, appears to have considerable influence with the authorities. We presume this concession will establish a precedent for the future, and that no more free lighting will be exacted on new lines. It would be interesting to know the reason why the Metropolitana tramway was let off, and why the Capital and the Belgrano companies were not.

**E.P.S. Cells.**—Mr. J. W. Barnard, of Great Winchester Street, is circulating a new list (January, 1899), of the Q. and V. type batteries. Additional warehouse and factory premises have been opened at 13, Brownlow Street, Holborn, W.C., to meet increasing business.

**Fire.**—On Friday last a fire broke out at the premises of the General Electric Company, Limited, in Queen Victoria Street, but it was got under by the Brigade in less than an hour, and business is being carried on as usual.

**Hart Secondary Battery.**—We are informed that in future the Hart Secondary Battery Syndicate, Limited, will trade under the name of "The Hart Accumulator Company, Limited," which has a capital of £40,000.

**Kensington and Notting Hill Electric Lighting Bills.**—The Hammersmith Vestry have lodged a memorial in opposition to the passing through Standing Orders of the Bill jointly promoted by the Kensington and Knightsbridge Electric Lighting Company and the Notting Hill Electric Lighting Company for powers to acquire lands for generating stations. The Vestry allege that, as the road authority in Hammersmith, they were entitled to certain notices which the companies have not given them, as required by the Standing Orders, and further that the plans and sections deposited by the companies are erroneous.

**The Large Power Schemes.**—Allegations of non-compliance with the rules of Parliament were made last Friday in connection with two of the new electric supply Bills. In the case of the Leicestershire and Warwickshire Electric Supply Company's Bill, memorials of non-compliance had been lodged on behalf of the Corporation of Loughborough; Erdington Urban District Council; Aston Manor Urban District Council; Rugby Urban District Council; the Corporation of Sutton Coldfield, and the Urban District Councils of Ashby-de-la-Zouch, Coalville, and Swadlincote; Lewis Beard. Several of these were held by the examiner to have been sustained, and the non-compliances will be referred to the Select Committee on Standing Orders, who will decide as to whether they can be excused or not.

The Lancashire Electric Power Company's Bill has been declared not to have complied with the Standing Orders.

**List.**—Messrs. Elliott Bros. send us an illustrated list of their various patterns of electrical recording instruments.

**Manchester.**—Messrs. W. E. Partington & Co., of Levenshulme, report that they have just finished the complete installation of electric light in the works and offices of one of the largest textile machinists in the world, part of the requisite current being obtained from the Manchester Corporation.

**Partnership.**—Messrs. Newsome, Pinching & Co, electrical and mechanical engineers, of 1, Crutched Friars, E.C., have taken into partnership, Mr. W. H. Walton, late electrical engineer to the Draper's Company. In future, the style of the firm will be changed from Newsome, Pinching & Co., to Newsome, Pinching and Walton. The firm's tube conduit specialities proved very successful last year, being used on several important installations.

**Private Bills.**—The *Times* says that further attendance was given last week at the Private Bill Office, Westminster Hall, to receive any memorials which might be presented alleging non-compliance with the Standing Orders in respect of the second hundred of Bills deposited for consideration during the ensuing session. Amongst the memorials were one from the Vestry of Hammersmith and others in regard to the Kensington and Notting Hill Electric Lighting Bill; one from the Metropolitan Electric Supply Company, Limited, in regard to the St. Marylebone Vestry Electric Lighting Bill; while in the case of the measures promoted by the National Telephone Company there were in each case memorials from the corporations of Glasgow and Edinburgh. With regard to the National Company's Bills it is alleged that the notices given by the company of their intended application to Parliament were defective, insufficient, vague, and misleading. It is alleged that the notices were not published in the manner prescribed by the Standing Orders, in newspapers circulating in the cities and districts affected by the Bills, whilst the notices that were given in the London, Edinburgh, and Dublin

"Gazettes," contained no intimation of some of the principal provisions in the Bills. Among the measures on Monday's list to which no opposition is to be offered before the examiners, are the London United Tramways Bill, Central London Railway Bill, and the City and Brixton Railway Bill.

**Smoke Nuisance.**—The City of London Electric Lighting Company, it will be remembered, was recently fined for causing smoke nuisance. The company has now written on the subject to the St. Saviour Board of Works pointing out that the electricity works were of considerable magnitude, and comprised 33 boilers of 600 horse-power each, but there were only two shafts, or a percentage of 16·5 boilers for each shaft, and about 10,000 horse-power per shaft. In an ordinary way, there would be 40 shafts erected, but in these works, special provision was made by which that large number was dispensed with. It had been said that Welsh coal should be used, but to alter their furnaces would entail a great deal of trouble and considerable time. It was hoped that the Board would not force the company to take that step. The Board of Works decided to express sympathy with the company in its trials, and to state that the Board was not the maker, but the administrator of the law.

**Stegmann v. O'Connor.**—On Tuesday in the Queen's Bench Division before Mr. Justice Bruce and Mr. Justice Ridley, sitting as a Divisional Court, the case of Stegmann *v.* O'Connor, which has been previously reported, and which was the plaintiff's appeal from the decision of Mr. Verey, the Official Referee, was again mentioned in consequence of the Court being differently constituted to what it was when the case was formerly before the Court. The plaintiff, Mr. G. Stegmann, who is an electrical engineer, asked their Lordships to set aside the decision of the Official Referee on the ground that such decision was against the weight of evidence. In 1898, the defendant, the owner of a house at Clapham, required an installation put down, and Mr. Harris, his architect, prepared specifications. The contract was given to the plaintiff, and he proceeded to execute it. During the course of the work, however, Mr. Harris complained that it was not being done according to the specification, and was not completed in the time provided by the contract, the consequence being that another engineer was called in to execute the work. The plaintiff, on the other hand, contended that the work was properly carried out, and he brought his action to recover £76 10s., the amount of the contract. The Official Referee allowed a certain amount for the actual value of the work taken over by the engineer who was subsequently called in by Mr. Harris, but gave a penalty of £50 for the non-completion of the work by the plaintiff within the time specified by the contract, the result being that judgment was entered for the defendant on the claim and counterclaim for £38 1s., and hence the present appeal of the plaintiff. Mr. Tindal Atkinson appeared for the plaintiff in support of the appeal, and Mr. Clavell Salter for the defendant.—At the conclusion of the arguments their Lordships intimated that they would see Mr. Verey on the matter, and give judgment in a few days. It might be that the case would have to go back to the Official Referee.

**To Creditors.**—Creditors of the London and Hampstead Battery Company (in liquidation) are notified in our advertisement pages that particulars of their debts or claims must be lodged with the liquidators by March 1st.

**X Rays.**—Mr. G. Stegmann sends us a copy of his Röntgen ray list, in which he describes and illustrates the various apparatus necessary for doing practical or experimental work. We understand that Mr. Stegmann has equipped a laboratory at 45, St. John's Hill, Clapham Junction, with a 12-inch installation, which is being well patronised by the hospitals and medical men of the locality.

## ELECTRIC LIGHTING NOTES.

**Asylum Lighting.**—The Visiting Committee has decided to light the Suffolk Lunatic Asylum by electricity. Gas at present costs 5s. per 1,000 cubic feet. The estimated cost of the installation is £5,300, with £740 per annum for maintenance, including £425 for interest on capital outlay and depreciation.

**Bethnal Green.**—The Vestry will join with the Battersea Vestry in opposing the Bill of the County of London and Brush Company.

**Bexhill-on-Sea.**—There is a suggestion made in the local press that the Council should hand over its electric lighting order to the British Electric Traction Company, so that it may carry out the powers in connection with the proposed electric tram scheme.

**Birkenhead.**—The Town Council has resolved to apply for a license to supply electricity for lighting and other purposes to the townships of Bidston-cum-Ford and Noctorum, which are outside the borough boundary. Practically all the houses along the route of the proposed mains have applied for current.

**Brecon.**—In connection with the mayor's promise to carry on an electric light installation for the town, arrangements are being made with an expert to advise and report.

**Canterbury.**—The tender of the National Free Wiring Company for the wiring and fitting of the Sidney Cooper Gallery of Art, the management of which has just been made over to the Town Council by its founder—Mr. Sidney Cooper, R.A.—has been carried out. The light will be tried at the Gallery of Art before the end of the month as an experiment.

**Carnarvon.**—A local paper says that Messrs. Lake & Co. are about to apply for power to light their premises with electricity. The motive power will be obtained from the Seiont Mills, and it is believed that sufficient current can be obtained, if necessary, to provide the whole town.

**Cowes (I.O.W.).**—The Gas Committee are ascertaining what Messrs. Edmundsons' Electricity Corporation would pay for the transfer of the provisional order.

**Dawlish.**—The Urban Council is asking Messrs. Taylor and Field, consulting engineers, who are advising Teignmouth Council on the electric lighting question, what their terms are for reporting on the lighting of Dawlish.

**Dewsbury.**—The extension of electric light mains to Westbro' is being proceeded with at a cost of £1,360, under the supervision of Mr. O. M. Jonas, borough electrical engineer.

**Doncaster.**—The Board of Guardians has decided to invite tenders for the lighting of the new workhouse by electricity.

**Dorking.**—The Council has now asked Mr. Trentham to submit a detailed report on electric lighting.

**Douglas (I.O.M.).**—There is a scheme on foot to have the property outside the town boundaries in North Douglas lighted with electricity.

**Dundee.**—In view of the increasing demand for current, the authorities are making the necessary arrangements to have the area of lighting extended. The work would have been in hand sooner but for the recent unfavourable weather. The mains are in the first instance to be extended to the northern district of Dundee, this including the greater portion of Hilltown. A new main is also to be laid in a westerly direction. The existing plant in the electric lighting station is fully employed, and in order to provide the increased power additional plant will have to be provided. Plans and specifications are now being prepared for the new machinery, which will consist of boilers and engines equal to 1,600 horse-power. For the accommodation of this extra machinery new buildings are to be erected. While the lighting of the streets by electricity will in all probability be extended from time to time, the scheme adopted so far has been all but completed. In all 45 electric pillars have been erected in the centre of the city.

**Ealing.**—The Council passed several minor matters relating to the electricity works last week, including some slight alterations in the working staff and the purchase of two bicycles. There are now 21,698 8-C P. lamps applied for and 20,470 connected.

**Fort William.**—The Fort William Burgh Commissioners last week discussed the West Highland electricity scheme, and pledged itself to support the Bill.

**Glasgow.**—At last week's Council meeting Bailie Battersby asked whether at any of the stations the Electricity Committee had under their charge at the present moment there was sufficient space to admit of the erection of new works for generating electricity on the high tension system. Bailie Maclay said he had pleasure in answering that question. It was well enough known that they spent some £40,000 on the acquisition of ground for two new sites, one on the north side and the other on the south side of the city, and there they had ample room and scope for expansion, and plenty of accommodation for putting down special plant for the working of the high tension system.

**Hospital Lighting.**—The Eccleshall Board of Guardians has instructed the architect to ascertain the cost of lighting the new hospitals and administrative block by electricity.

**Hampstead.**—As reported in the REVIEW of the 13th inst., the Hampstead Electric Lighting Committee recommended that Messrs. Allingham & Fennell, electrical engineers, should be prosecuted for having connected two consumers to the mains of the Vestry without the latter's authority; but as the firm in question had practically apologised, and one of the consumers had offered to pay for the current that had inadvertently been used, the Vestry decided that the matter be further considered by the Committee. At the last meeting of the Vestry the Committee reported that they, on full examination of the facts, were of opinion that the two consumers concerned were entirely innocent of the breaches of the rules and regulations of the Vestry, and that the firm of wiring contractors were primarily and knowingly guilty of such breaches, and that therefore, in pursuance of the power delegated to them by the Vestry, the Committee had instructed the vestry clerk to prosecute the firm and to caution the consumers concerned. In pursuance of this decision, Messrs. Alliogham & Fennell, electrical engineers, Harrow Green, Leytonstone, were summoned at Marylebone Court on 20th inst. for laying on a supply of electric light without the consent of the lighting authority of the Hampstead Vestry. Mr. A. P. Johnson, solicitor to the Vestry, said that the defendants were contractors, and had the order to put on a supply of electric light to the house of a gentleman living in Lyndhurst Road. The Act required that the fittings should be tested before the connection was made. An appointment was made for the test to be carried out, but the defendants did not keep it, and afterwards wrote saying that they would communicate when they were ready. About three weeks later one of the Vestry officials passed the house in question, and saw that the connection had been made without the knowledge or consent of the Vestry, and that all the rooms in the

house were illuminated. There was no meter fixed, but the occupier, who was an innocent party, had arranged to pay an agreed sum. A plea of "guilty" having been recorded, Mr. Curtis Bennett inflicted a fine of £3, with £1 3s. costs.

At Hampstead, on Tuesday, Messrs. Allingham & Fennell were summoned for connecting another residence to the Hampstead Vestry main without consent. Mr. A. P. Johnson, solicitor, the vestry clerk, prosecuted, and stated that, when the Vestry's meter fixer went to the house, in Thurlow Road, to connect the electric lighting wires of that house on to the Vestry's main, he found that the defendants had already made the connection without the Vestry's knowledge or consent. To do this they had had to break open the Vestry's fuse box, which was sealed. When the installation was tested it was found to be defective, and the connection was cut off. It was a very bad case, and there was danger of fire through it. By the connection having been made without the knowledge of the Vestry, all precautions which were laid down were rendered null and void. Mr. Allingham said that the light had been put on for only a short time, in order to test the lamps in the house. He denied that the fuse box was sealed. The Bench imposed a fine of three guineas and 23s. costs.

**Huddersfield.**—Alderman Calvert informed the Council last week that the cause of the recent breakdowns at the electricity works was, that the machinery was inadequate for the demands made upon it. The engineers' strike was blamed, presumably because the new plant was not forthcoming.

**Islington.**—A letter from a Committee of the Battersea Vestry was read by Mr. W. F. Dewey, clerk, at the last meeting of the Vestry, in reference to the Bill promoted by the County of London and Brush Provincial Electric Lighting Company to obtain powers to connect their areas of supply, and to break up the streets in the intervening districts to lay mains. The letter pointed out that the Committee were unanimous in a recommendation to be submitted to the Vestry to oppose the Bill, and as Islington was one of the districts affected by the proposal, the Committee asked the Islington authority to co-operate in objecting to the measure. The Committee invited the Vestry to express an opinion as to whether it would be advisable to hold a conference of all the local authorities concerned in order to consider the Bill, and as to whether the London County Council should be invited to render assistance in the matter. On the motion of Mr. Argyle the Vestry referred the letter to the Parliamentary Committee for consideration and report.

A report is to be brought before the Electricity Committee for lighting New North Road electrically.

**Lancaster.**—On 19th inst. a Local Government Board inquiry was held into an application to borrow £10,000 for extension of the electric light plant and system; £25,000 had been spent on the installation in 1894, and Mr. Councillor Hall (the chairman of the Electricity Committee) informed the inspector that since then there had been an increasing demand. It was proposed to put down plant which would increase the output by 75 per cent., from 241 kilowatts to 420. Large buildings outside the borough had been wired in anticipation of the development, and the application had the unanimous support of the Council. The capital expenditure up to date was £26,969 11s., and the profit on the past year, after providing for the redemption, was nearly £600.—Mr. J. Cock, borough engineer, said there were now 350 consumers, and the output last year was 182,145 units.

Mr. C. M. Johnston, the borough electrical engineer, having resigned that position to go to Shrewsbury to occupy a similar post, a successor is to be advertised for at £200 per annum.

**Leeds.**—The managers of the Adel Reformatory have asked the Property Committee of the Leeds Corporation to provide a 6 horse-power boiler, an oil engine, and an installation of the electric light.

**Leyton.**—There was a failure for half an hour in the supply of electric light for a number of shops along the Broadway, Stratford, on Wednesday last week.

**Liverpool.**—At a recent City Council meeting Mr. C. Petrie, in proposing the adoption of the proceedings of the Electric Power and Lighting Committee, pointed out that since 1895 the Committee had put up 255 new lamps in old streets, 878 passage lamps had been fixed, lighting the back entrances to 20,607 houses, 3¾ miles of road had been lighted by means of electric arc lamps, and 76¼ miles by means of incandescent gas lamps, the total number of lamps in use to date in the old city amounting to 11,646, with an illuminating value of 1,165,838,947 candles, at a cost of £36,012. The Committee proposed during the next few years to light the whole of the city with incandescent lights, which would cost about £20,000 or £25,000, but it would not mean any increase in the rates. Mr. Grant inquired whether there was any possibility of lighting the streets of Liverpool by electricity instead of incandescent lights, but Mr. Petrie said it would not be possible at present. Such an undertaking would mean an enormous increase in the rates, and he was not prepared to propose it. The proceedings were approved.

At last week's meeting of the Electric Power and Lighting Committee, it was reported that the number of electric lights now used by private consumers in Liverpool is upwards of 93,000, as against 67,600 at this date last year. The Board of Trade units supplied during the last month were 532,000, as against 365,000 in the corresponding period of 1898.

**Llandudno.**—The Council has retained Mr. A. H. Preece as consulting electrical engineer for three years. The chairman of the Council said that they had come to a very satisfactory arrangement with Mr. Preece, "whose father was severing his connection with the Government the following month."

**London.**—The St. Luke's Vestry has appointed a special committee of eight members to consider and report upon the desirability, or otherwise, of the Vestry applying to the Board of Trade for a provisional order for the supply of electricity in the parish, with power to secure the requisite technical assistance.

**Marylebone.**—The Vestry has resolved to present a petition against the Bill promoted by the Central Electric Supply Company.

**Merthyr.**—The sub-committee appointed to deal with the proposed electric lighting of Merthyr by the British Electric Traction Company has reported to the Council. The company not having adopted the conditions submitted by the Council, the Board of Trade has been notified of the opposition of the Council to the scheme.

**Monmouth.**—A representative of Messrs. Bramwell and Harris reported to the last Council meeting that the electric lighting works are nearing completion, and a supply of current will be available in March.

**Northfleet.**—The Works Committee is to consider the question of lighting by gas and electricity.

**Partick.**—The Electric Lighting Committee has reported to the Commissioners on the terms of agreement with the Glasgow Corporation for a supply of electricity. The Commissioners will discuss the terms.

**Pontardawe (Glam.).**—The District Council Committee has resolved to recommend the acceptance of Mr. Player's tender for lighting Cwm Clydach with electric light. Mr. Player's charge is £3 5s. per 32-C.P. lamp, and a contract for five years has been entered into.

**Rotherhithe.**—The Vestry will oppose the application of the County of London and Brush Company for a provisional order, as one company already has powers for the district. It was pointed out that if the new order is secured the Vestry, when it wants to take over the electric lighting, will have to purchase two undertakings.

**Salford.**—The Town Council last week considered a recommendation from the Electric Light Committee to appoint Messrs. Lacey, Clirehugh & Sillar as consulting engineers for three years at a remuneration of £500 per annum. The discussion was eventually adjourned to a special meeting on Wednesday.

After further discussing the matter on Wednesday, the following amendment was carried unanimously:—"That Messrs. Lacey, Clirehugh & Sillar be appointed consulting engineers providing the Electric Light Committee give the Council an undertaking to set aside the present specifications and start *de novo*." The undertaking was given.

**St. James's, Westminster.**—A letter from the St. James's and Pall Mall Electric Lighting Company was placed before the Vestry at the last meeting in reply to a representation made on the subject of the charges for the supply of electricity in the parish. The company stated that they had decided to give, as from January 1st last, a special discount to all consumers, amounting to 8 per cent. on their accounts under the current scale. A memorial was submitted from ratepayers in Carnaby Street and neighbourhood, protesting against the proposed extension of the electric light station of the same company.

**Tivoli.**—Messrs. Ganz & Co., of Buda-Pesth, are at present engaged on the construction of four large three-phase alternating dynamos for the electricity generating station at Tivoli, near Rome. The generators are said to be by far the largest so far constructed in Europe.

**Wallasey.**—The District Council will oppose the Lancashire Electric Power Company's Bill.

**Weymouth.**—A committee of the Town Council is considering whether to transfer the electric lighting powers to Messrs. Edmundsons' Electricity Corporation.

**Whitechapel.**—The District Board is applying to the London County Council to borrow £60,500 for the electric lighting scheme embodied in Mr. Arthur Wright's report. The loan is to be repayable in 42 years, repayment of principal to be deferred until after a period of five years from the date of the loan.

**Wimbledon.**—The Urban Council has appointed Mr. Spencer as its resident electrical engineer.

**Whittington.**—The District Council has appointed a committee to consider the electric lighting question, with power to call in expert advice if desirable.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Aberdeen.**—The Tramways Committee has been authorised to go to Glasgow to examine the tramway system there, with a view to considering the method of traction to be adopted for the Woodside route.

**Ardrossan.**—A proposal to introduce electric cars to run between Ardrossan and Saltcoats was recently discussed by the Ardrossan Commissioners, and it was agreed to grant an interview to representatives of the British Electric Traction Company.

**Colombo.**—Experimental runs of the new electric trams were to be made on New Year's day. An American engineer, Mr. May, arrived on Christmas Eve and took possession of the plant at the central station, which ran well. Four conductors and 16 motor men had been engaged when the last mail left, the motor men being all youths drawn from local schools and colleges.

**Devonport.**—The last Council meeting was occupied with a consideration of the tramway question. It was proposed to give notice to the Plymouth, Stonehouse, and Devonport Tramways Company, their successors or assigns, requiring them to sell that part of their undertaking within the borough of Devonport to the Corporation. The idea was that Plymouth and Stonehouse would do likewise. Plymouth and Devonport, it seems, have written to the company, inviting them to a conference *re* purchase, and suggesting that if the company wished to negotiate a lease, the authorities would consider it; but it must be understood that it would be required that the lines should be relaid to a 3 feet 6 inches gauge, and doubled throughout the entire length, also that the overhead trolley system be substituted for horse traction, the work to be done within two years. Each authority would retain the right to supply the traction current, the company not being allowed to do so. A new syndicate has made a proposal, the terms of which were not divulged.

**Dublin.**—Sir Francis Marindin, the Board of Trade inspector, has submitted his report on the inspection of the Donnybrook electric tramline, and of the Rathmines to the Sea tramline, to the Board of Trade. He certifies the Rathmines to the Sea line as fit for traffic, and that it has been properly equipped and satisfactorily laid. The road is a very wide one, and a speed of 10 miles an hour might be sanctioned. As regards the Donnybrook line, on the portion inside the city boundary the speed must, according to the recent resolution of the Corporation, be limited to seven miles an hour, although the roads are so wide and open that Sir Francis Marindin did not think there would be any risk if the cars were run at eight miles an hour, with a limit of six miles an hour round the curve at the south-east corner of Merrion Square. Outside the city the local authority wished for a higher rate of speed, and, in the inspector's opinion, 10 miles an hour might be safely allowed as a maximum, with a limit of eight miles an hour from Baggot's Bridge to the junction with the line at the end of the Pembroke Road, six miles an hour round the curve at this junction, and round the curve at the junction with the tramway in Waterloo Road, and four miles an hour through the village of Donnybrook from Eglinton Terrace to Church Lane. Speed indicators must be attached to the cars for guidance of the drivers.

It is stated that as the result of the recent Board of Trade inquiry in Dublin, with reference to the speed of the electric trams on the Dalkey and Kingstown line, Sir Francis Marindin, who held the inquiry and personally inspected the line, has reported in favour of an increase to 10 miles an hour on wide roads, including the interval between Haddington Road and Williamstown. The present speed of the trams is eight miles an hour.

**Early Trains Wanted.**—Postal employés are agitating for an early morning service of trains (3 30 and 4.30 o'clock) on the City and South London Railway.

**Edinburgh.**—The Lord Provost's Committee last week approved of a report by their Sub-committee recommending that no action be taken on a motion by Councillor Alexander Gray as to the Portobello section of the tramways being worked by electrical power.

**Glasgow.**—The Town Council having resolved to equip all the tramways of Glasgow on the trolley system, Mr. John Young, the general manager, has submitted a report to that body, giving an outline showing how the scheme of conversion can be proceeded with. He says:—To save time, I have prepared an outline showing how the scheme can be gone about. I have, at the same time, had estimates prepared for the first section, so that, with your approval, the work may be proceeded with as soon as possible. The site of the exhibition indicates the routes which must be first dealt with, and it is important to bear in mind that the conversion of routes with the closest service will set free the most horses. We must also see that we can provide the necessary depôt accommodation for the electric cars on the routes to be first dealt with. These considerations lead me to suggest that the routes which best lend themselves to early conversion be taken in the following order:—"1. The first is the main east and west route, from Whiteinch to Dalmarnock and London Road *viâ* Bridgeton Cross. The conversion of this route would free about 800 horses. Fortunately we have spare ground at both Partick and Dalmarnock depôts. This ground can be at once covered with sheds for 56 electric cars, as per plan submitted. Pits or passages would be provided underneath the cars throughout. The adaptation of the present buildings can be gradually carried out after, so far as necessary. The estimated cost of these sheds is as under:—

| | |
|---|---|
| Partick ... ... ... ... ... ... | £3,750 |
| Dalmarnock ... ... ... ... ... | 2,500 |
| Total ... ... ... | £6,250 |

2. The second route to be dealt with would naturally be from Overnewton to Cross Hill and Langside, and this would free about 450 horses. 3. Polloksbaws and Shawlands and Pollokshields routes from Eglinton Toll outwards, would either be equipped simultaneously with No. 2, or immediately after. These routes might, for a time at any rate, be joined up with the Springburn route, and the turning of cars in Mitchell Street discontinued. The Oatlands branch from Crown Street might also be included here. These routes would free about 300 horses. It is chiefly on Coplawhill depôt that we must depend for accommodation for the electric cars on the routes embraced under 2 and 3, as also for the cars for the Govanhill route now in hands. Here, again, by the minutes of last Thursday, this department has timeously become possessed of the spare ground to the west and north of the present depôt buildings at Coplawhill. The west or lower portion of this spare ground, lying between the present buildings and the railway, could be at once roofed in, so as to form additional car works accommodation, and room for storing and dealing with the electric cars. To cover this ground as per plans herewith, including an ashlar front entrance from Albert Road, is estimated to cost £25,000. The proposed erections at Partick, Dalmarnock, and Coplawhill, would thus give the necessary accommodation for dealing with the electric cars on the foregoing routes, and with your approval, we could have the plans and specifications ready, so that offers could be advertised for early next month. The specifications for the conversion of the permanent way could also be proceeded with. Each route would be specified in sections, so that several squads could be simultaneously at work on the same route. The overhead construction would, of course, be a separate contract. The estimated cost of converting the permanent way, and completing the overhead construction for Nos. 1, 2, and 3, would be as follows:—

| | | |
|---|---|---|
| 1. Permanent way alterations and renewals, including bonding and ducts for feeders, and also overhead construction .. | £56,000 | |
| *Less*—Cost of renewal of lines in ordinary course .. .. | 32,000 | |
| | | £24,000 |
| 2. Permanent way alterations and renewals, including bonding and ducts for feeders, and also overhead construction .. | £38,000 | |
| *Less*—Cost of renewal of lines in ordinary course .. .. | 22,000 | |
| | | 16,000 |
| 3. Permanent way alterations and renewals, including bonding and ducts for feeders, and also overhead construction .. | £21,000 | |
| *Less*—Cost of renewal of lines in ordinary course .. .. | 7,000 | |
| | | 14,000 |
| | | £54,000 |

4. Following next in order would come the route from Parkhead to Paisley Road, or rather the portion of it from Glasgow Cross eastwards and from Eglington Street westwards, the central portion having been already dealt with under Nos. 1 and 2. The conversion of this route would free about 480 horses. Accommodation for the electric cars could be provided by roofing over the spare ground at the Kinning Park and Whitevale depôts. Estimates for this work can follow later. It may be premature to put in order the remaining routes—viz., Maryhill and Mount Florida, Dennistoun and Kelvinside, Woodlands Road line, Possilpark and Govan. These would follow in natural course, and in the order most practicable." The scheme will be considered at an early meeting of the Sub-committee on Electric Traction.

The Firemaster (Chief Officer Paterson) in his report for last year, says: "During the past year the introduction of the overhead trolley system on the Corporation tramways has necessitated the use of India-rubber gloves at all fires within the area. No accident from this cause has occurred to any of the staff or the plant of the department. At the same time, the reported extension of the system the Firemaster views with some anxiety. It not only increases the danger of our occupation, but imperils our electric system, on which we now place so much reliance." And in spite of this the Corporation proceeds with its scheme for the equipment of all the lines with the trolley. Really, it is too bad!

The new electric car route from Glasgow Cross to Springburn was opened on 22nd inst.

**Intercommunication between Electric Railways.**—The Parliamentary Committee reported to the Islington Vestry on Friday, having considered a letter from the Westminster Vestry, drawing attention to recent notices of proposed applications for powers to construct underground electric railways in the metropolis. The latter Vestry expressed the opinion that if electric railways were further increased, the work should only be done on a comprehensive plan, which would enable all districts to be served, and that the lines should be so laid out as to be able to converge their traffic to fixed points, where passengers desiring to go from one extreme district to the opposite extreme district could be accommodated. Having fully considered the subject, the Parliamentary Committee recommended, and the Islington Vestry decided, to take no action in the matter.

**Ipswich.**—It is stated that the solicitors to the company which propose to acquire the Ipswich trams for the purpose of working them by electric traction, have received notice that the Committee appointed to examine the scheme will recommend the Town Council to refuse consent to the provisional order. It is understood that the Town Council propose to acquire the trams themselves.

**London United Trams.**—On 20th inst. the Board of Trade further considered the objections of the Great Western Railway Company to the confirmation of the Hanwell and Uxbridge light railway order. Sir Courtenay Boyle announced that the Board had carefully considered the case since the adjournment, and had decided that there was not such an amount of interference with the Great Western as to take the matter out of the Light Railways Act, which might reasonably be held to apply to this scheme. Mr. Earl appeared for the Middlesex County Council in opposition on the ground of its interference with the traffic and injury to the road, and especially as the tramway company were going to carry goods as well as passengers. Opposition was raised by frontagers who thought the value of their property would be diminished. Mr. Earl said the objection of the Middlesex County Council was that they had to maintain the seven miles of road proposed for this electric traction, and if heavy goods

traffic were carried it would add very much to the cost of maintenance. The average width of this road for seven miles was only 26 feet. Sir Courtenay Boyle reserved the decision of the Board of Trade as to whether the order should be confirmed or modified.

**Manchester.**—The Tramways Committee, on 24th inst., further considered the question of the overhead trolley system of electric traction as against the conduit system, and reaffirmed their recommendation in favour of the first named. The Committee's decision was unanimous. The question is to be again raised in the City Council at its meeting in February.

**Melbourne.**—A Melbourne paper says that Mr. Arnot, the electrical engineer of the City Corporation, in the course of evidence before the Electric Traction Committee, said that the only obstacle to the introduction of electric trams was the additional expense which would be entailed. Speaking generally, he thought it would be well to postpone experiments in that direction for at least 12 months, with a view to watching the tests now being made in the old country.

**Oldham.**—The Oldham Tramways Bill has been found to comply with the Standing Orders, and no memorial has been presented against it.

**Southampton.**—The Town Council on Wednesday decided that the Bargate should not be removed or mutilated in order to carry out the scheme of working the trams by the overhead system of electricity. The difficulty will probably be met by lowering the level of the roadway.

**Thanet.**—Mr. Murphy and Mr. Salter, promoter and engineer respectively of the Thanet Light Railway and Electric Light Company, have interviewed the Minster (Thanet) District Council in regard to the new order for which the company were applying, for the extension of the works sanctioned by an order granted last year. The discussion was principally in regard to the extension of the electric tramway from Margate along the Canterbury Road as far as Birchington Square, and from thence to the Birchington Railway Station. Mr. Murphy said the company were willing to supply the electric light to Westgate and Birchington as well as Margate.

## TELEGRAPH AND TELEPHONE NOTES.

### Telegraphic Interruptions and Repairs:—

| Cables. | Down. | | Repaired. |
|---|---|---|---|
| Amazon Company's cable— | | | |
| Cable beyond Gurupa ... | June 11th, 1898 | ... | ... |
| Para-Maranham ... ... | Nov. 14th, 1898 | ... | ... |
| Landlines. | | | |
| Majunga-Tananarive ... | Jan. 14th, 1899 | ... | Jan. 20th, 1899. |
| Indo-European lines (between Kertch and Soukhoumkale ... ... ... | Jan. 23rd, 1899 | ... | Jan. 23rd, 1899. |

**Overhead Telephone Wires in Islington.** — The Islington Vestry on Friday referred to the Works Committee for action a letter from the National Telephone Company in reference to the conditions recently imposed upon the company in regard to overhead telephone wires of spans exceeding 116 yards. The company stated that every endeavour was being made to reduce the length of the spans, but that it was of course impossible without compulsory powers to undertake generally to shorten the spans. At the same time the length of some of the wires had been diminished, showing that satisfactory progress had been made. In case of necessity application would be made for an extension of time, but in the event of that not being granted the company would take down the wires. An intimation to this effect would be given to the Vestry which, the company concluded, would perhaps take into consideration the question of the convenience of subscribers in the matter. At the same meeting the Works Committee recommended the Vestry to consent to the erection by the company of certain wires in existing spans of over 115 yards, on the same conditions as recently laid down.

**Alternative Cable Routes.**—The *Times* letter to which we referred last week has drawn from Mr. Rippon, the general manager of the Direct West India Cable Company, the statement that communication to the West Indies has not been a matter of uncertainty since the opening of the Direct West India Cable Company's cable, connecting Halifax, N.S., with Jamaica, "*vid* Bermuda," on January 31st, 1898? He adds: "This is a line supported by the British Government, and forms part of the all-British cable system, which I would like to point out to your correspondent and others has already been established."

Mr. Brown, manager and secretary of the West India and Panama Telegraph Company, also says: "There was no interruption of telegraphic communication as far as the cables to the United States and thence to, and throughout, the West Indies were concerned. My company connects with seven Atlantic cables and two from the United States to Cuba, and itself owns a system in the West Indies duplicated throughout, thus affording the greatest security of any routes communicating with our British West Indian possessions."

**The Telephone Question.**—The following are the resolutions to be proposed at the Guildhall Conference to be held on Wednesday next, February 1st, into the telephone question:—"(1) That this conference of delegates, representing the London County Council, the Corporation of London, and the other local authorities within the London telephone area, is of opinion that a joint application should be made for a telephone license for the London telephone area, in accordance with the resolution passed by the Court of Common Council on November 17th, 1898—viz., 'That application be made for a license to establish a telephone service in conjunction with the London County Council and other local authorities within the London telephone area.' (2) That this conference is of opinion that the London telephone service should be managed by the London County Council and the Corporation of London. (3) That this conference recommends a joint application to the Postmaster-General for the telephone license, in accordance with the foregoing resolutions. (4) That these resolutions be submitted to the various authorities represented at this conference for their confirmation."

The Parliamentary Committee of the Sheffield Corporation recommends that body to petition against the proposed new Bills of the National Telephone Company, and also to petition Parliament in favour of the granting of municipal telephone licenses.

**Edinburgh Telephone System.**—Sheriff Rutherfurd, in Edinburgh Sheriff Court on 22nd inst., had before him an application on behalf of the Postmaster-General asking the consent of the Lord Provost, Magistrates, and Council for consent to the placing and maintaining of a line or lines of underground telegraphs in or under a number of roads. The application was objected to, because the wires were intended for the use of the Telephone Company as part of their undertaking, and the Corporation objected to giving any rights in the streets to private or commercial undertakings whether applied for directly or through the medium of the Post Office. The Solicitor-General and Mr. Fleming appeared for the Post Office, and the Dean of Faculty and Mr. F. T. Cooper for the Corporation. The Sheriff made avizandum of the application.

**Paris Telephones.**—It is officially announced, according to a Dalziel telegram, that on and after 1st prox. the Paris public will be able to make use of a new system of communicating by telephone. On payment of 25 centimes a message can be sent to any person within a radius of 25 kilometres stating that the sender of the message will call his correspondent, either on his own telephone or at a public call room, at an hour to be notified in the message. For any distance exceeding 25 kilometres the charge will be 40 centimes. These telephone "calls," as they are entitled, will be transmitted by telephone by the postal officials, and will take the place of the telegrams which it has been necessary to send as advice of telephone calls.

**A German Cable to the States.**—The *Daily News* Berlin correspondent says that at Cologne a joint stock company has been founded with a capital of half a million to lay a direct cable from Germany to the United States.

**Sydney Telephones.**—A Sydney paper says that satisfactory progress in regard to the telephonic system in the colony continues to be made. The total number of subscribers at the end of November was 8,078, the number of telephones in use being 9,110. Since January last the connections made amounted to 1,700.

**Brussels Telephones.**—During this year there is to be opened in Brussels a spacious building which, according to *Commercial Intelligence*, will be devoted exclusively to the telephone business of Belgium. The building has cost nearly £40,000, and is fitted up for 15,000 subscribers. Nearly all the Brussels wires are to be laid underground on the twin-wire system.

**Cardiff Telephones.**—The Cardiff Chamber of Commerce has passed a resolution in favour of Government control of the entire telephone service of the country.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Belfast.**—February 2nd. Tenders are wanted for cast-iron pipes, frames, and covers, earthenware conduits, cables, and Lancashire boilers. See "Official Notices" January 13th.

**Bradford.**—February 1st. Tenders are wanted for an installation for electric lighting at the Hammerton Street destructor for the Corporation. Specification may be obtained at the Electricity Department, Town Hall, Bradford.

**Buxton.**—February 6th. The District Council wants tenders for feeders, mains, and arc light leads. See "Official Notices" January 20th for particulars.

(*Continued on page* 131.)

## EQUIPMENT OF THE BROADWAY CABLE LINE WITH ELECTRICITY.*

In recent issues of the *Scientific American* we have described at considerable length the important changes which are being made in the great system of surface roads owned and operated by the Metropolitan Street Railway Company. These changes include the construction of four important north and south lines of railway on the underground trolley system on Second, Fourth, Sixth, and Eighth Avenues, with connecting cross lines at Fifty-ninth and Canal Streets, the changing of the Broadway and Lexington Avenue lines from the cable to the underground trolley system, and the equipment of a crosstown line from the Hudson to the East River with compressed air motors. When the work which the company has now in hand is completed, 90 miles out of the total of 228½ miles owned by the company will be mechanically operated. In the course of time it is intended to apply electric traction to the whole system, with the exception of some crosstown roads. If the use of the compressed air motor on the Twenty-third Street line shows good results, it will be adopted on other crosstown lines.

The electric roads are entirely new construction, the old horse car tracks having been removed *in toto* to make way for the cast-iron yokes and massive 107-lb. rails, which are the standard construction for all the new electric roads. On the Broadway road, on the other hand, the whole of the original track construction is available, and the changes are confined to laying of the cable ducts and bolting the conductor rails to the lower flanges of the slot rails within the conduit.

The ducts are laid in a trench which is excavated at the side of the tracks and slightly under them, as shown in the accompanying illustration, fig. 1. Two kinds of duct are used, one consisting of riveted sheet iron pipe, about 4 inches in diameter, lined internally with cement, forming the top layer of 20 pipes, the other being made of terra cotta in short lengths of about 2 feet.

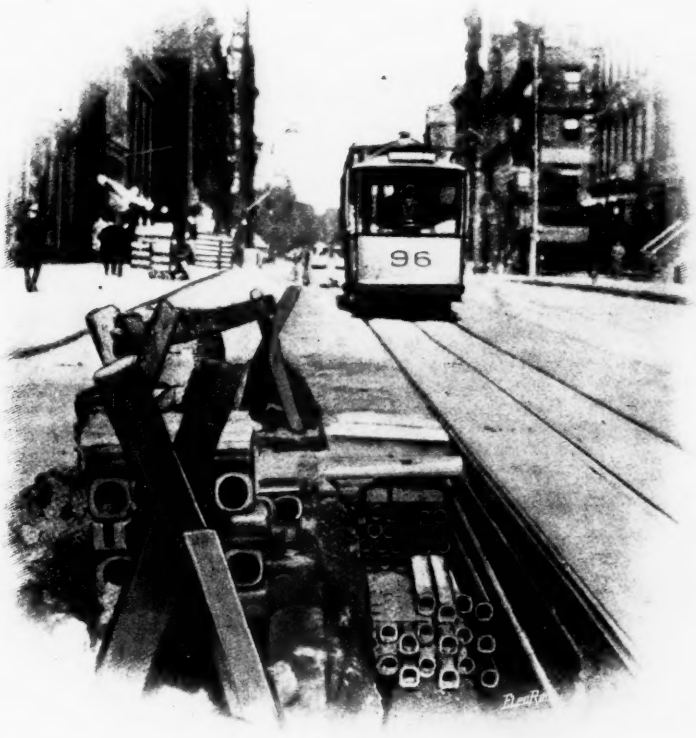


Fig. 1.—Laying Ducts for Electrical Equipment of Broadway Cable Road.

The object of these numerous ducts is to carry independent conductors to different sections of the road, providing current, in case of accident to one section, to all the others, reducing to a minimum the possibility of delay on long stretches of road at a time.

The terra cotta ducts are preferred for the high tension current cables. In laying the ducts, the bottom of the trench is levelled and covered with from 4 to 6 inches of concrete. The ducts are then arranged symmetrically in layers, and cement grout is run in between them to fill up the voids and bind the whole mass together. The sides and top are also concreted in, thus insuring that the continuity of the several lines of duct shall be preserved unbroken. Piles of these ducts will be observed on the sidewalk to the left ready to be placed in position. This work of transformation is going on without the least interruption to the regular cable traffic.

The conductors consist of two lines of T-shaped rail weighing 21 lbs. to the yard, which are suspended below the cable slot by means of insulators attached to the lower flanges of the slot rails. The insulator consists of a circular cast-iron cup, provided with lugs by which it is bolted to the slot rails. Within this cup is another of porcelain, which is held firmly within the cast-iron cup by cement. The porcelain cup holds a 1½-inch wrought-iron shank to which the conductor T-rail is bolted.

To enable the conductor rails and their supports to be put in place, two handpole boxes are being placed, one on each side of the slot, at every 15 feet of the Broadway track. The conductor rails will be in 30 foot lengths, so that it will be possible to slide them into the conduit at the handholes. They will be supported at the ends and at the middle. After the insulators and conductors have been passed in through the handholes and bolted up and the wiring to the cables in the ducts completed, the Broadway road will be ready for the electric cars, which will commence running early in 1899.

The present Broadway cars can be utilised by equipping them with motors, and replacing the present grip by an electric plow. It is probable, however, that new and larger cars of the type at work on the present electric roads of the company will be supplied for this, the most important artery of travel in New York city.

In the underground trolley system, as now being installed, the track rails play no part in the electric circuit. The current is conveyed to and from the motor by means of the plow, one side of the plow receiving the current from the feed conductor, and the other side delivering it to the return conductor. The shank of the plow consists of three steel plates, the outer plates being $\frac{1}{8}$-inch, and the inner plate $\frac{3}{16}$-inch in thickness. The conductors, which are wrapped copper ribbons, are carried down through the plow to the contact shoes or wipers, connection being made between them by flexible cables. The shoes are of cast-iron, and measure 4 inches by ½ inch. They are kept in contact with the conductor rails by means of side steel springs, which keep the shoes 8 inches apart when free, and 6 inches apart when they are in contact with the conductor rails. It has been found that a pressure of about 6 lbs. is sufficient to insure good electrical contact between shoes and conductor.

The engraving, fig. 2, shows a portion of the new underground trolley road in course of construction in Canal Street. Under the slot is seen the sheet iron drain tube, and to the right another form of terra cotta ducts, each section having four tubes about 6 feet long. By comparing it with the view of the Broadway road it will be seen that the new track is considerably heavier. The rails, weighing 107 lbs.

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* *Scientific American*

to the yard, are not only the most massive used in any street railway, but they are several pounds heavier than the largest rails used on the steam railroads, where the most massive rails do not exceed 100 lbs. to the yard.

Current for the whole of the underground system, including the Broadway line, is eventually to be furnished from one great central station at Ninety-sixth Street and the East River. It will have a capacity of 70,000 horse-power, or over four times that of any existing power station in this country. The plant will consist of 87 water-tube boilers of 800 horse-power each ; 11 cross-compound engines, each of 6,600 horse-power, and 11 direct connected three-phase alternating current generators. The current, at 6,000 volts, will be led to eight sub-stations, conveniently located with reference to the various lines. Here it will be converted by static and rotary converters to a pressure of 550 volts, at which it will pass to the conductors.

## LONDON AND BIRMINGHAM UNDERGROUND CABLE.

The paper insulated cable now being laid between London and Birmingham will be the longest of the kind that has hitherto been undertaken, and its progress will be watched with great interest in view of the important results which may follow from its successful completion.

The cable used is of the lead-covered paper insulated air space type, and is being manufactured by the British Insulated Wire Company, Prescot, and the Western Electric Cable Company, North Woolwich.

The general terms of the specification are as follows:—

"*Conductors.*

"Each conductor to consist of a solid wire of pure annealed copper smoothly drawn, cylindrical, uniform in quality, free from all defects, and having a standard weight of 150 lbs. per statute mile, and measuring neither less than 96 nor more than 98 mils. in diameter.

"The minimum conductivity of the copper to be 100 per cent. according to Matthiessen's standard of pure soft copper.

"The maximum resistance per statute mile at 60° F. to be 5·852 standard ohms.

"The wires in each length should be free from joints.

"*Dielectric.*

"Each pair of conductors to be wrapped with strong, specially prepared paper, free from metallic particles, in such a way as to completely enclose the wires, and to perfectly insulate them both from each other and from neighbouring conductors. During the wrapping process the conductors of each pair are to be uniformly twisted so as to make at least one complete turn in every 12 inches. The insulated pairs are then to be stranded into a compact and symmetrical cable, the following arrangement to be maintained throughout :—Centre, 1 pair ; first layer, 6 pairs ; second layer, 12 pairs ; third layer, 19 pairs.

"Additional paper insulation is to be laid on spirally between each completed layer of pairs, so as to form a suitable bed for the next layer. A final wrapping of at least one thickness of paper, or of other suitable fibrous material, is to be added between the outer layer and the lead sheath hereinafter described. The cable thus formed is to be carefully and thoroughly dried at a temperature not exceeding 225° F.

"*Lead Sheath.*

"The cable to be sheathed with the finest English lead, applied at a temperature not exceeding 600° F. The lead sheath to form a perfectly continuous, cylindrical tube, free from pinholes, defects, and flaws of every kind, and to have a uniform thickness of 160 mils. Its diameter is not to exceed 2·625 inches as an absolute maximum measured across its major axis, no margin being allowed beyond this figure. The sheath of any single length of cable to contain no mended place whatever.

"*Capacity.*

"(*a*) The electrostatic capacity of each wire measured against all the remaining wires of the cable, and the lead sheathing as earth, shall not exceed ·1 M.F. per mile at a temperature not less than 50° F.

"(*b*) The mean electrostatic capacity from wire to wire of each pair in any length, all the wires in the cable, and the testing battery and apparatus, being insulated, shall not exceed ·065 M.F. per mile.

"*Insulation Test.*

"The insulation resistance, when tested, to be not less than 10,000 megohms per statute mile after one minute's electrification at a temperature of not less than 50° F. The galvanometer readings during the test to indicate perfectly steady electrification.

"The cable to be tested dry, and the ends to be metal capped and sealed immediately the tests are completed.

"The insulation tests to be made with not less than 600 volts."

Equipment of the Broadway Cable Line with Electricity.

Fig. 2.—Construction of New Underground Trolley Road on Canal Street, New York City.

The cable is drawn into 3-inch cast-iron socket pipes, laid in sections of 150 yards, leaving a gap between the sections of 4 feet 2 inches for the purpose of jointing the sections of cable. These pipes are laid at a depth of 2 feet below the surface of footways, and 2 feet 6 inches below the surface of roadways, which depths will ensure against crushing by heavy weights passing over the roads. As a further safeguard the cable is laid under footways wherever footways exist.

The pipe laying is done by contractors, under the supervision of the engineer in charge, and special precautions are taken to ensure that the pipes are full bore, clean, and free from any projections or roughness on the inner surface. The

person who inspects the pipes on the ground is a responsible officer of the department, and the method of inspection is as follows:—Each pipe is laid on trestles breast high; a gauging disc $2\frac{15}{16}$ inches in diameter attached to the end of a long iron rod is passed through the pipe to prove the bore; a bright sheet of tin is then held a few inches away from one end of the pipe, and this enables the inspector, by looking through from the other end, to see clearly the whole of the inner surface of the pipe. If accepted as a suitable pipe, it is marked and passed on to the pipe layers.

CABLE ON CARRIAGE BEING TAKEN FROM RAILWAY DEPOT TO WORKS.

The trench is dug in as straight a line as local conditions will permit, and the sections of pipes are regulated by the Department's officer before the ground is allowed to be filled in.

An iron wire is threaded through the pipes as they are laid, for the purpose of drawing the pulling rope into the pipes, and as each section of pipes is completed this wire is turned into the mouth of the pipe, and a plug of hard wood inserted to keep water and grit from entering.

CABLE IN POSITION OVER JOINT HOLE.

As the pipes are being laid a chart is prepared giving measurements in order that the jointing places can be readily identified by the cable gang.

At the present time four contractors are engaged laying pipes, viz.: Mr. Peattie, of Oxford, Mr. Atkins, of Kingston-on-Thames, Messrs. Worthington and Pownall, of Manchester, and Messrs. Reid Bros., of Wharf Road, City Road, London.

The drums of cable are drawn from the railway depôt to the works on specially constructed carriages, or "floats" horsed by local contractors. A joint hole is opened up by the cable gang, a drum of cable is placed in position and mounted on screw jacks, over the hole, the pulling clip is attached to the end of the cable, the end of the cable with clip attached is then dipped into a saucepan of boiling paraffin wax in order to fill up all interstices, and

PAYING CABLE INTO PIPES.

thus prevent any water which may have accumulated in the pipes from penetrating to the core of the cable.

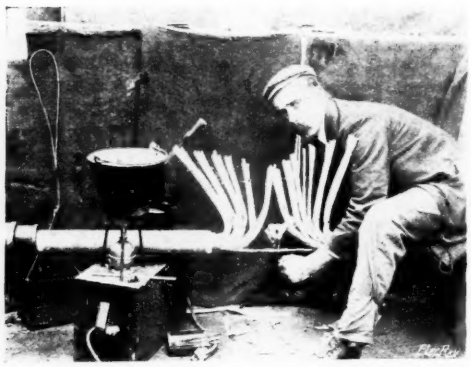
One end of the pulling rope is now made fast to the iron wire before mentioned, and at the same time a sponge of white yarn is attached so that as the pulling rope is being drawn through the pipes the sponge clears out any grit which may have found its way into the interior. The other end of the pulling rope is then passed round the barrel of a crab winch at the other end of the 150 yards section of pipes.

HAULING ON CABLE.

The Crab winch is anchored by the following means: A hole is dug on the line of pipes about 3 yards away from the pulling end, and the Crab winch is lashed down by means of ropes to the pipes. As the cable enters the pipes, and while it is being drawn in it is liberally lubricated with petroleum jelly, and when the full length is drawn in the clip end is sawn off, and the ends of the cable, after being carefully sealed by means of a lead disc and solder, are then

laid down in the trench, and after being carefully protected by pieces of timber, the ground is filled in.

As lodging accommodation cannot be obtained in the



CABLE JOINT BEING MADE.

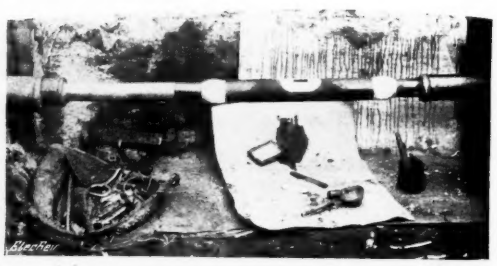
villages for the whole of the men comprising the cable gang and jointers, the work is so arranged that the jointers are about five miles in rear of the cable gang, so that as the

TESTING FOR MOISTURE.

cable men vacate their lodgings the jointers are ready to occupy them.

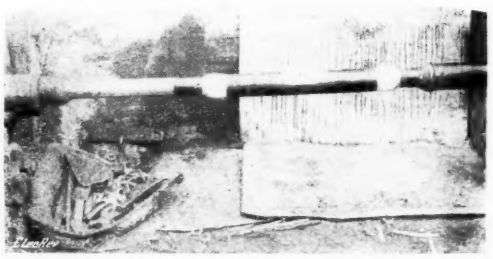
### JOINTING.

A joint hole having been opened up, a sheet of iron is laced under the ends of the cables, a similar sheet is placed



CABLE JOINT WITH LEAD SLEEVE FIXED, SHOWING LAST VENT HOLE.

on each side against the earth, a tent is erected over the hole, and canvas sheets are suspended round the sides of the hole in order to make the opening as warm and dry as possible before exposing the core of the cable. Owing to springs and running water it is frequently found necessary to dig a sump hole in the trench and keep a lift pump at work during the operation of jointing, and occasionally it is necessary to keep two such pumps at work at one hole.



LAST OPERATION: VENT CLOSED.

A cast-iron slide pipe is now passed over the end pipe exposed in the hole and a lead sleeve over the end of the cable, the latter is then opened out to a convenient length

GENERAL VIEW OF JOINTERS' TENTS.

and the jointing commenced. The wires are turned back and tied together in flakes, and the jointing commences with the bottom pair. The conductors are jointed by means of a split copper tube, tinned inside and out; a paper sleeve is drawn over the joint, and the pairs of wires are tied lightly together with thread.

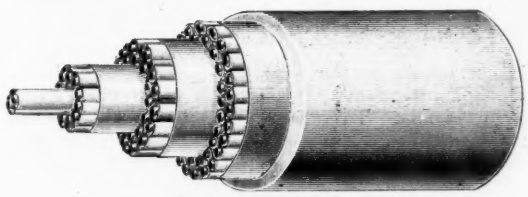
IRON SLIDE DRAWN OVER JOINT.

When the whole of the wires are jointed, they are tested for continuity, and proved to be in proper order, without crosses, and then the whole joint is thoroughly baked by means of charcoal braziers, in order to dry out any moisture. The presence of moisture is detected by means of a piece of silvered glass, which is placed over the joint, and which indi-

cates the slightest trace of moisture while the cable is being baked.

As the jointing proceeds in all weathers, the time occupied in drying a joint varies from one to two hours, according to the amount of moisture in the atmosphere.

After the conductors are jointed, the lead sleeve is drawn over and fixed by means of a plumber's wiped joint. A small vent hole is left in the upper part of the lead sleeve, and as a final test for moisture, the silvered glass is placed

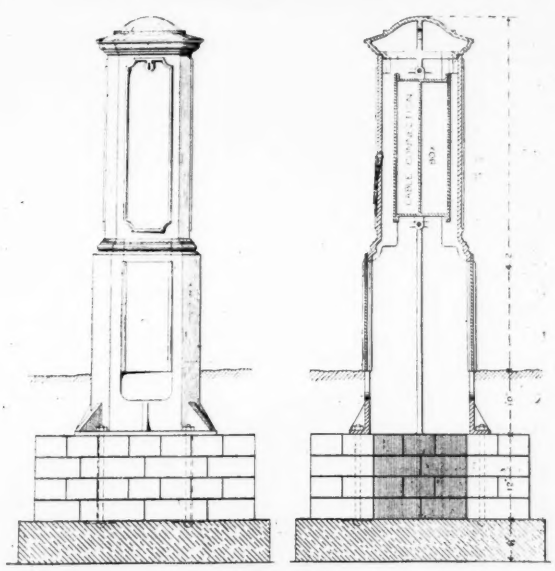


View of Cable.

over this hole, when, should the test be satisfactory, a lead cap is "wiped" on, and the joint is then complete. The iron slide pipe is now drawn over the cable joint, and this is yarned and leaded in the usual way.

At distances of five miles the cable is brought up to distribution boxes, fixed in test pillars, somewhat resembling a pillar letter box. In the boxes the wires are soldered to insulation pins, an iron partition divides the box through which the pins are fixed, the two ends of the cables are brought up the pillar to the pins at the back of the partition, and the wires are crossed over in front by means of short pieces of India-rubber covered wire. The distribution boxes are furnished with iron covers, which are fixed by means of gun-metal set screws. These boxes are provided for the purpose of testing, also for pumping dry air through the cable, should the necessity for this arise in the future.

The route of the cable from the General Post Office is *viâ* Newgate Street, Farringdon Street, St. Pancras, Chalk Farm, Cricklewood, Hendon, Edgware, Stanmore, Watford, Hemel



Test Pillar.

Hempstead, Leighton Buzzard, Fenny Stratford, Towcester, Weedon, Southam, Leamington, Warwick, Kingswood, Horkley Heath, thence *viâ* the Old Stratford Road to Birmingham Post Office, a distance of 116 miles.

The cable is completed as far as Fenny Stratford, a distance of 50 miles, and several telegraph circuits are working through this section. A further section from Fenny Stratford to Weedon, a distance of 23 miles, will be ready for working in the course of two or three weeks. The insulation of this section is 28,000 megohms per mile.

Up to date 94 miles of pipes have been laid, 74 miles of cable have been drawn into the pipes, 980 cable joints, and 75,000 wire joints have been made.

## CONTRACTS OPEN AND CLOSED.

(*Continued from page* 126.)

**Christiania.**—February 26th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Christiania, stating that tenders are invited by the Norwegian State Telegraph Administration for the delivery of about 140,400 porcelain telegraph and telephone insulators. Tenders must be received at Christiania by 12 o'clock noon on February 26th, 1899. A copy of the specification, conditions, &c., may be examined on personal application at the Commercial Department of the Foreign Office any day, between the hours of 11 a.m. and 5 p.m.

**Ealing.**—January 30th. Tenders are invited by the Council for two 500-H.P. steam alternators and one 150-H.P. steam dynamo alternator. See our "Official Notices" January 13th.

**Glasgow.** — February 6th. The Corporation wants tenders for the reconstruction of tramways in Crown Street and Cathcart Road. See our "Official Notices" this week.

**Hull.**—February 8th. The Corporation wants tenders for the electric wiring and fitting of the tramways power station, Osborne Street. The contract will include 4 arcs and 40 incandescents. See our "Official Notices" this week.

**Italy.**—February 25th. Tenders are being invited by the municipal authorities of San Severa (Province of Foggia), for the electric lighting of the town. Tenders are to be sent to Il Municipio di San Severa (Foggia), Italy, from whence particulars may be obtained.

**London.**—January 31st. The L.C.C. is inviting tenders for four continuous current dynamos, one motor generator, two switchboards and switches, &c., for the proposed Victoria Embankment installation. See "Official Notices" December 30th, 1898.

**Lowestoft.**—February 6th. The Corporation wants tenders for the supply of boilers, steam dynamos and motor boosters, storage batteries, switchboard, travelling crane, mains, arc lamps and posts; and for the lighting of the station. Consulting engineer, Mr. W. C. C. Hawtayne. See our "Official Notices" January 6th.

**Southampton.**— Tenders are invited for one 100-kw. engine and generator, one boiler, a set of accumulators, 20 motors, &c. See our "Official Notices" this week.

**Stirling.**—January 30th. The Burgh Commissioners want tenders for electric light mains. See our "Official Notices" January 13th.

**Sunderland.**—January 27th. The Corporation wants tenders for roadwork, with stoneware casings, and supplying and laying electric light cables. See our "Official Notices" January 13th.

**West Hartlepool.**—February 13th. The Corporation wants tenders for feeders, mains, arc light leads, and road work. See our "Official Notices" this week.

**Whitechapel.**— February 7th. The Board of Works wants tenders for cables, arc lamps, steam dynamo, batteries, boilers, and other machinery and apparatus for electricity works. See our "Official Notices" January 20th.

### CLOSED.

**Edinburgh.**—The Corporation is stated to have placed an order for electric switchboards with Messrs. Mather & Platt at £9,136.

## FORTHCOMING EVENTS.

**Friday, January 27th.**—At 5 p.m. Physical Society. Agenda: "On the Equivalent Resistance and Inductance of a Wire to an Oscillatory Discharge," by Edwin H. Barton, D.Sc., F.R.S.E.; Exhibition of (*a*) A Dephlegmator, (*b*) A Temperature Tell-Tale, by R. Appleyard; "On the Volume Changes accompanying Solution," by T. H. Littlewood.

At 7·30 p.m.—Smoking Concert of Telephone Athletic Association, Westminster Town Hall.

At 8 p.m.—Institution of Junior Engineers. Lecture on "Measurements of Elasticity," by Prof. J. A. Ewing, F.R.S.

At 8 p.m.—Smoking Concert of the Electrical Engineers (R.E.) Volunteers, Holborn Restaurant.

At 8 p.m.—Electro-Harmonic Concert.

**Saturday, January 28th.**—At 7 p.m. Institution of Junior Engineers. Annual dinner, Westminster Palace Hotel.

Institution of Electrical Engineers.—Students visit to the works of the Electric Welding Company, Hindon Street, Pimlico, S.W., on Saturday January 28th. Students' Secretary, Mr. M. Solomon, 22, Linden Gardens, Bayswater, W. Party limited to 30. Meet at the Institution, 28, Victoria Street, at 10.15

**Wednesday, February 1st.**—At 7.30 p.m. Institution of Electrical Engineers (Students' meeting). Paper by Mr. Sidney Ransom on "Safety Fuses."

## NOTES.

**"Electrical Review" Central Station Sheet.**—A few copies of the above list, which was published as a supplement with our last issue, can be obtained, post free, mounted on linen, at 2s. each, unmounted 1s. each, upon application to the publishers.

**Trades Union Progress.**—From the recent Board of Trade report, it appears there are now (1897) in Great Britain 1,287 unions, or 21 less than in 1896, but the total membership had grown to 1,609,909, as against 1,491,007, or nearly 8 per cent. Of the members only 7 per cent. were females, chiefly in the textile trades, which embrace 91 per cent. of all female unionists. Thus about 21 per cent. of all male adults in employment are in some union. Omitting fishermen and agricultural labour, the percentage rises to 25 of the total disbursements by 100 of the principal societies in six years of an amount of about 9¼ million sterling, 23½ per cent. went in fighting, 59½ in benefits, and 17 as working expenses. The total income was nearly 10 million, so that these hundred societies saved over one million in six years. Nineteen societies of about 167,000 members had balances of from £3 to £13 per member. Thirty-four societies of a quarter of a million members had balances of from 1s. 4d. to 20s.; and over 60 per cent. of the total membership of all the societies had balances of £1 to £3. In 1897, the average balance of all members was £2 2s. 11d., and the expenditure 96 per cent. of the income.

**The Boiler Explosions of the Year 1898.**—The year for boiler explosions ends June 30th, and the report of the Board of Trade has been now issued. Some 84 explosions came under the Act, and caused the death of 37 persons, and the injury of 46 others, but 15 of those killed were killed by accidents which occurred on board ships. The deaths exceed the average of the past 16 years, which is a little over 29, but the injured fall considerably below the average. Marine boilers head the list of investigated explosions, and vertical boilers come next. Generally, the figures are very favourable to our existing system of voluntary commercial inspection. Of course, many of the so-called explosions investigated by the Board are not really explosions, and a good deal of ridicule has been cast upon some of their reports and methods. We believe, in one instance, the melting out of a fusible plug was set down as an explosion. We believe that, considering the number of steam boilers in Great Britain, the explosions bear a favourable ratio as compared with those in other countries, and the comparative freedom from explosion is largely to be credited to the various boiler insurance companies. We note a steady increase in the total of explosions for 16 years from 45 to 84, with a minimum any one year of 37, and a maximum of 114, the average being 70. There are, of course, more boilers now than then. The years containing the winters of '93 and '94 are notable as the worst, the explosions being 104 and 114. Were not these two winters both remarkably severe? This would possibly serve to explain the remarkable increase of boiler explosions during the period. The number of minor explosions reported from ships, as compared with minor explosions from land boilers, is large. This is held to be due to the neglect to supply any information as to some of the so-called minor explosions of land boilers. Steam users are not generally anxious to bring down a Board of Trade inquiry upon themselves, and if a ½-inch steam pipe should happen to develop a leak, possibly they keep the knowledge to themselves. The interference of the Board of Trade has not been an unmixed blessing. It has certainly not tended to increase the respect felt towards Board of Trade officials nor boiler inspectors by steam users who have felt that these men were poking their noses into business they did not understand.

**The Nernst Lamp.**—On Wednesday, February 8th, Mr. James Swinburne will read a paper before the Society of Arts on "Nernst's Electric Lamp."

**Sir James Sivewright.**—Electrical men will be interested in the fact that Sir James Sivewright has been unseated from his place in the Cape Parliament as a result of the inquiry held into the Stellenbosch election petition.

**Grimshaw's Smokeless Stoker.**—In the Grimshaw mechanical stoker there is a difference from the ordinary practice of sprinkling stokers, to which class this stoker belongs, in that there are fixed certain plates, which can be adjusted by levers in a manner to vary the sprinkling, so that the fuel may be directed upon the fire in a more even manner. The sprinklers themselves are simply a pair of two-bladed revolving paddles, which strike the coal as it falls from a hopper above, out of which it is pushed by a slowly reciprocating plunger device. In tests of the stoker made by Mr. M. Longridge, a report of which lies before us, it would appear that these above directing plates were very satisfactory in their action, and that at as low a combustion rate as 11·7 lbs. per square foot of grate there was no difficulty in keeping the grates covered, with satisfactory evaporation and but little smoke. Thick fires proved to be quite unsuitable for the machine, and are not claimed by the makers to be suited to it. Some of the figures obtained during the tests, which extended over nine days, are interesting. At the lowest fuel consumption of 11·7 lbs. per square foot of grate the gases left the boiler at 385° F., and they left the economiser at 211° F., only adding 120° to the feed water, which entered the boiler at 164° F. The evaporation from and at 212° was 11·89 lbs., an excellent result, but the total evaporation was only 4,131 lbs. At the maximum rate of combustion of 35·1, or three times the minimum, the water evaporated was 12,430 lbs., or over treble. The unit of evaporation was 11·44 lbs. The gases left the boiler at 729°, and the economiser at 379°, adding 173° to the feed and sending this to the boiler at 217°. The apparent reason for the better economy of the heavier test with higher chimney temperature was that in the one test there was nearly 8 lbs. of excess air, and in the other fully 2 lbs. less. This was partially due to the leakage of air through the chain holes, &c., of the economiser, but partly and chiefly to better conditions in the furnace, the ratio of $CO_2$ in the gases from the boiler flues going up from 11·3 to 12·6 per cent. There are doubts expressed as to this heavy test being quite accurate, but all the tests give very good results, and show that a steam boiler and economiser can be worked with comparatively little economic difference over a wide range of power. As between three tests when 11·7, 26·4, and 35 lbs. of coal were consumed per square foot of grate the heat utilised was respectively 81·5, 79 and 76 per cent. We are glad to see that Mr. Longridge so pointedly draws attention to the question of air leakage into flues by giving the figures of the air ratio present in the boiler flues, and after the economiser has been passed. We have long been persuaded of the serious loss of efficiency which results from air leakage at damper slots, economiser chains, and bad joints generally in brickwork walls of side flues, and have often advocated the painting of such walls to close up the pores of the bricks. The losses thus avoided are more serious than usually imagined. At its best, a steam boiler consumes much over the theoretical quantity of air which it ought to do for perfect combustion. In the present trials, the air excess has certainly been kept very moderate.

**A Gas Company's Pipes and Electrolysis.**—The *Street Railway Review* says that last October Judge Richardson heard the suit of the Spokane (Wash.) Gas Company against the Washington Water-Power Company, which owns the Spokane Street Railway, for $100,000 damages for alleged electrolysis of the gas mains. The gas company had as exhibits a number of pipes showing the effect of electrolysis. Prof. E. Darrow, of the Washington Agricultural College and School of Science, and Bert L. Baldwin, consulting engineer, of Cincinnati, made an examination of the conditions existing between the pipes and rails, and found them very bad. In many places the difference of potential of 50 volts was found, the pipe being positive; in other places this condition was reversed, and there was also an extended area of neutral territory, where there was practically no difference of potential between the rails and pipes. As much as 75 amperes was found flowing in a single pipe line. The case was stubbornly contested, and our contemporary has not yet heard the result.

**Personal.**—The King of the Belgians has appointed Mr. W. H. Massey, M.Inst.C.E., an officer of the Order of Leopold, in recognition of his services as British representative on the superior jury at the International Exhibition at Brussels.

**Railway Electrician Killed by Electric Light Wire.**—The *Street Railway Journal* records the circumstances under which Clement Wise, one of the night inspectors of the Toledo Traction Company, died from a shock received from an arc lamp circuit :—

At 3.40 a.m. on November 2nd, in company with the trolley trouble man, he was taking care of the wires while a house was moved across the tracks at Williams and St. Clair Streets. It was necessary to move an arc lamp at this point and it was lowered. Wise and the trolley man took hold of the wooden cross arm just above the lamp and started with it to the pole to hang it there temporarily until the house had passed. As the two men were about to step on the kerb the line man cautioned Wise to be careful of the catch basin cover. In some way Wise came in contact with either the wire or the frame of the lamp, but as the wire was covered with good rubber insulation it seems that his wrist must have come in contact with the chimney of the lamp. He fell instantly, but rose again and took two or three steps and then sank to the ground unconscious. The men tried to revive him according to printed instructions posted at headquarters and succeeded in starting his breathing. In removing him to a place of shelter he died on the way. The circuit of which this lamp was a part was connected to a 125-arc machine and carried about 110 lamps at a voltage between 4,000 and 5,000. The accident occurred a short time before the street lamps were extinguished, after which the circuit was tested with a 50,000-ohm magneto set and proved clear of grounds. In reporting the unfortunate accident some of the newspapers did not clearly distinguish between the trolley wire and the light wire as the cause of his death. It will be noted that the voltage of the electric light circuit was nearly ten times as great as that of the trolley wire and proportionally far more dangerous, and still death did not result instantly.

**Cord Communication in Trains.**—The North-Eastern Railway have been making experiments with a train fitted with a new means of enabling passengers to signal the driver. This is no less than a means of putting the air brake into action, and stopping the train. A whistle is also caused to blow underneath the carriage in which the call has been made. Without questioning the wisdom of allowing passengers to control the brake—less undesirable, perhaps, than being murdered—there appears no provision for the passenger to call an alarm when the brakes have already been applied by the driver. The alarm would only make itself felt when the attempt was made to release the brakes. Unfortunately all these alarms are of least use in cases of the most determined assaults. There is no difficulty in pulling an alarm. The difficulty is in getting at it. One is considered sufficient for a compartment, and it is too far out of reach of any passenger who may be suddenly attacked by superior strength. As to the present cord communication outside the window, within reach of a long arm on a tall man, the idea is so preposterously ridiculous, that no one but a railroad director would ever have fitted such a foolish contrivance. The floor cord on the Chatham and Dover line is far better, but easily cut, and rendered useless. Ability to apply the brakes is a step in advance, but it might easily happen, as pointed out above, that they might already have been applied, and there would be delay in securing attention.

**Wanted, a Lad!**—The *Practical Engineer* quotes the following advertisement as an interesting illustration of the methods employed by boiler users to safeguard the welfare of those whose business it is to be near steam boilers whilst at their work. It appeared in the *Rochdale Observer* recently, and reads thus :—"Wanted, a lad about 16 years of age to look after a vertical boiler and assist in moulding shop.—Apply to T—— S——, Brass Founder, L—— Street." It will be noted that any previous experience with boilers is not even mentioned, and constitutes, in the language of a correspondent to whom we are indebted for this curio, a very fair sample of an explosion tell-tale. However, we presume that a few more lives will have to be spent ere the lesson of prudence will have been learnt thoroughly. Perhaps if a bishop or a peer could arrange to be martyred public opinion would advance a little more quickly.

**Municipal Trading.**—Major Flood Page has written a long letter to the *Times* on the question of municipal trading, the clauses in a number of applications for provisional orders in which electrical trading powers are sought, supplying him with a text. In Wednesday's *Times* the correspondence is continued by Lord Wemyss and Mr. R. P. Sellon. Lord Wemyss hopes with Major Flood Page that a Joint Committee of the two Houses of Parliament will be appointed to consider what limits should be put to "municipal trading."

**Another Water-Tube Boiler.**—The *Street Railway Review* describes a very compact water-tube boiler—the Worthington. In this boiler there is a longitudinal steam drum, into which short lateral straight tubes discharge from the top of the terminal boxes of two sloping sets of tubes. The lower boxes of each set of tubes are connected by short tubes to mud drums placed parallel with the steam drum and fed with water from this by sloping down corners $\wedge$ fashion. The mud drums carry the grate, which forms the base of the $\wedge$, and the furnace is contained in the flattened pentagon formed by the grate, the two sets of main tubes $\times$ and the short connectors from the lower points of the $\times$ to the mud drums. The side of the furnace is bricked. In the illustration accompanying the description the two sets of $\times$ tubes are seven in depth, and are closely packed in these sets of seven, alternating as to slope from end to end of the boiler. Thus the $\times$ with steam drum above resemble in end view a skull and crossbones. The down corners at each end are just outside the extreme end rows of inclined tubes. The grate extends all the length of the boiler which is cased in sheet iron with suitable admission doors. The products of combustion rise direct from the furnace amongst the tubes. Evidently the boiler is designed for hard American coal or anthracite, for which it seems well fitted, or it would do for coke, but is impossible for bituminous coal, being in no sense arranged for this class of fuel, nor, indeed, can it be. A 25 H.P. boiler is said to occupy little space, only 9 feet 4 inches $\times$ 8 feet 9 inches $\times$ 10 feet over all, from which dimensions we should say that 250 H.P. is intended. Firing can be from the ends or sides as desired and arranged. Records of tests do not show anything very striking in evaporation. All the pipes are straight. With a flue feed heater the boiler would certainly be very compact and useful with good feed water, and as the tubes are short they should be cleaned easily.

**What was the Cause? The Jury's Finding.**—On Thursday last week, Mr. Walter Schroder, deputy coroner, resumed at the Lambeth Coroner's Court the inquest on the body of Samuel Pugh, aged 32 years, an engine driver employed on the City and South London Electric Railway, and who was found dead on his engine at Stockwell station on the 10th inst. The deceased, who lived at 34, Gaskell Street, Clapham, went to work on the 10th inst. just before seven o'clock, and shortly after taking charge of his engine was found dead on the locomotive with his feet resting on the switchboard. Dr. Morris, who made the autopsy, said death in his opinion was due to syncope following an electric shock, but the inquest was adjourned in order that a further examination might be made. Dr. William Murray Leslie, of 67, Grosvenor Street, S.W., said he had made a post-mortem examination together with Dr. Nicol Henry, of 175, Kennington Road, and Dr. W. J. Bell, of 316, Clapham Road, and in his opinion death was due to heart failure following syncope. He found no signs of an electric shock, and unhesitatingly attributed death to a natural cause. Dr. George Nicol Henry said he thought death was due to syncope. He could not say death was not due to electric shock, but he found no evidence of it. Dr. Noel Bell corroborated Dr. Morris's opinion as to the first examination, and said if he thought it possible deceased could have received an electric shock he should have attributed death to that cause. In the absence of anything to show that he should say death was due to a natural cause. Dr. Morris was recalled, and said he adhered to his former opinion that death was due to an electric shock. He held to that view because he could find nothing in the natural condition of the deceased which would account for the sudden death. The jury returned the following verdict :—"The deceased was killed by an electric shock, but we do not know how it was caused." They added that they were unable to say whether it was caused accidentally or not.

**What does this Mean?**—A *River Plate* exchange recently said :—

A telegram from the United States is to the effect that the Committee of Naval Constructions have, after a lengthy study of the reports received from officers taking part in the naval engagements against Spain, resolved to reduce the electric service on board warships as much as possible, as it has been proved that for certain applications it is useless.

**Design of Transformers.**—A highly mathematical paper by Mr. Frederick W. Carter, entitled "The Design of Transformers," was read at the November meeting of the American Institute of Electrical Engineers, in which the author attempts the useless, if not impossible, feat of laying down a system of transformer design consisting entirely in the use of equations, more or less complicated. The accompanying table (reproduced from the *American Electrician*) is taken from the paper, giving the data of six transformers, columns 1 and 4 relating to types of commercial transformers, and the other columns to designs calculated by the author :—

DATA OF TRANSFORMERS.

| | One. | Two. | Three. | Four. | Five. | Six. |
|---|---|---|---|---|---|---|
| Output in kilowatts | 5 | 5 | 5 | 3 | 3 | 3 |
| Primary P.D. in volts | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Secondary P.D. in volts | 100 | 100 | 100 | 100 | 100 | 100 |
| Frequency of alternations, in periods per second | 100 | 100 | 100 | 100 | 100 | 100 |
| Maximum secondary current, in amperes | 50 | 50 | 50 | 30 | 30 | 30 |
| Cross section of secondary wire, in sq. cms. | 0·383 | 0·383 | 0·383 | 0·204 | 0·204 | 0·204 |
| Maximum current density, in amperes per sq. cm. | 130·5 | 130·5 | 130·5 | 147 | 147 | 147 |
| Number of convolutions in the secondary | 48 | 34 | 35 | 24 | 42 | 45 |
| Ratio of mean to maximum ohmic loss | 0·835 | 0·835 | 0·835 | 1 | 1 | 1 |
| Ratio of mean to maximum hysteresis loss | 0·99 | 0·99 | 0·99 | 0·985 | 0·985 | 0·985 |
| Thickness of core plates, in mils | 13·3 | 13·3 | 7 | 15 | 15 | 7·5 |
| Thickness of insulation between core plates, in mils | 1·7 | 1·7 | 1·7 | 1·85 | 1·85 | 1·85 |
| Maximum ohmic loss, in watts | 100 | 94·8 | 89·5 | 60 | 63·6 | 58·3 |
| Maximum hysteresis loss, in watts | 79·5 | 76·8 | 87·4 | 81·5 | 59·3 | 67·2 |
| Maximum eddy current loss, in watts | 20·5 | 16·0 | 5·7 | 20·5 | 15·2 | 5·3 |
| Maximum total loss, in watts | 199 | 187 | 181·6 | 160·5 | 137 | 129·7 |
| Mean total loss, in watts | 182·5 | 171·1 | 167 | 160·5 | 137 | 129·7 |
| Magnetic induction in iron, in lines per sq. cm. | 3,900 | 2,290 | 3,130 | 2,670 | 2,810 | 4,400 |
| Weight of copper, in lbs. | 61·5 | 58·5 | 55 | 29·2 | 30·9 | 28·4 |
| Weight of iron, in lbs. | 130 | 294 | 202 | 230 | 153 | 87 |
| Drop of secondary voltage at full load, due to copper losses only, in volts | 2 | 1·9 | 1·79 | 2 | 2·12 | 1·95 |
| Radiating surface per watt wasted, at full load, in square inches | 375 | 5·3 | 4·9 | 5·0 | 4·6 | 3·85 |

**The Declining Use of Rubber as an Insulator.**—The New York *Electrical World* recently contained the following editorial comments on this subject :—

> Wherever the insulation of electrical lines is enclosed in a watertight sheath, as is commonly done in subterranean work, it has been found that cheaper materials will serve in place of the preparations of caoutchouc. In telephone work, particularly, paper insulation has been found not only cheaper but better than rubber, owing to its lower specific inductive capacity, the insulating material being used dry, giving a large amount of entrained air between conductors. In electric lighting and power work paper is also used, but treated or saturated with insulating compounds that increase its breakdown strength, and cables are now regularly put out with paper insulation of a thickness per 1,000 volts of $\frac{1}{75}$th of an inch. For overhead series arc lighting and the primary circuits of alternating current distribution systems rubber-covered wire is still largely used, although its depreciation is considerable, owing to the gradual vulcanisation of the rubber by the sulphur contained in the atmosphere, especially in smoky districts. For interior wiring rubber is still used, and owing to the fact that lead sheathing is going out of fashion inside of the armouring of interior conduits, the use of paper insulation will be impracticable in this location. Many substitutes have been found for hard rubber, notably vulcanised fibre, moulded insulations, and many imitations which closely resemble hard rubber in all its desirable qualities. It is well that the use of rubber is diminishing, as the material is rather an uncertain one, not so much due to the fault of manufacturers as to the difficulty of controlling the operation of those who gather the raw material. The supply is also rapidly becoming exhausted owing to the enormously-increased demands of electrical and vehicle work, and the rubber plant will soon have to be cultivated to supply the market.

The author of these statements does not appear to be well inspired. There is no doubt that in the extending field of electricity many other insulators are now finding a place, and paper plays an important *rôle*, but that the use for India-rubber is declining is quite incorrect. The output in insulated wires and cables increases yearly, not only for internal house wiring but for mains. The writer remarks that the depreciation of rubber is considerable owing to the gradual vulcanisation of the rubber by the sulphur contained in the atmosphere. This enables one to gauge both the accuracy and the amount of his knowledge.

**Presentation.**—Mr. J. B. Hyde, who has for some time past occupied the post of manager at the Ediswan Company's manufactory at Broadheath, Altrincham, has been the recipient, on his resignation, of a handsome marble clock and case of cutlery from the workmen.

**Corundum.**—Corundum, says the *Scientific American*, is composed of the oxide of aluminium ($Al_2O_3$), but traces of the oxides of other metals are generally present as colouring materials. As in the cases of other minerals of non-metallic lustre, the colour of corundum varies considerably. Sometimes the mineral is colourless or white, and at other times it is found possessing a blue, pink, red, brown, grey, or other colour. The relative weight of corundum compared with equal volumes of many other minerals is high. It has a specific gravity of about 4, while feldspar has a specific gravity of from 2·4 to 2·7 and quartz of 2·5 to 2·8.

**Engineers and American Competition.**—Upon all sides recommendations are heard in favour of the freer adoption of machinery and plant as the best way of meeting the growing American competition. The latest advice of this order, says the *Engineer*, was given by the new president of the South Staffordshire Institute of Iron and Steel Managers in his inaugural address. Mr. Le Neve Foster has had a good deal of valuable experience with some of the best firms in the kingdom, and when he dwells on the subject of iron and steel manufacture, he knows what he is talking about. He is evidently of opinion that British iron and steel masters need not fear American competition very much if they will but be willing to spend more money on machinery. He rightly insists with regard to this important point that capital is cheaper than labour, or, in other words, that machinery must take the place of brute force. He even believes that the men themselves will in time come to see that it is to their own ultimate advantage for labour-saving appliances to be employed, and he considers that as our workmen get better educated, they will not indeed be content to do work which can be better and more economically done by machinery. Mr. Foster evidently looks forward to an era of machinery, and since that would obviously be beneficial, not only to the iron and steel masters, but to the engineering trades, there are, at least, two good reasons for hoping that his anticipations may prove correct. It is a truism often forgotten that the success of an operation is the economy which can be effected by it; and there is nothing like machinery for effecting economies. It is largely machinery which makes £3 per ton an actual price for hematite steel in the States; and in the president's opinion its manufacture in England at the same price is "entirely a question of capital expenditure and large producing capacities, joined together with the best attainable technical knowledge and skill, as well as a perfect system of detail cost, not only of wages, but dealing with yields, so that the smallest leakage may be detected and rectified at once.

**The Royal Society.**—Among the papers down for reading yesterday afternoon was one by Mr. S. W. J. Smith, "On the Nature of Electro-Capillary Phenomena; I.—Their Relation to the Potential Differences between Solutions."

**Presentations.**—Last Friday Mr. J. Clifton Robinson, the very enterprising and popular manager of the London United Tramways Company, was presented with an illuminated address by the officials of the several companies of which he is managing director and engineer, as a token of esteem on the celebration of his silver wedding. Mrs. Robinson was presented with a beautiful diamond star brooch and ear-rings. A supper was given by Mr. Robinson to the men and their wives and sweethearts.

Mr. Joyce, who has been in the employ of the Killarney Electric Lighting Company, Limited, for the past six years as engineer, has left that company to take up a post with the Cork Electric Lighting and Tramways Company. On 18th inst. his friends at Killarney presented him with a handsome silver coffee service as a parting gift.

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**Appointments.**—Mr. Tiddman, of Pontypool electricity works, has been appointed electrical engineer to the St. Anne's Urban District Council at a salary of £170 per annum. There were 53 applicants.

Mr. Bird, of the Yorkshire House-to-House Electricity Company, has been appointed assistant engineer to the Bristol Electricity Committee at £175 per annum. There were 86 applicants.

Sergeant Brooks, R.E., has been appointed to succeed Company Sergeant-Major Instructor Batt in charge of the electric lighting machinery at the Chatham School of Military Engineering.

The Lee District Board of Works are wanting a consulting electrical engineer upon terms stated in our "Official Notices."

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**Appointments Vacant.**—The Manchester Tramways Committee wants an assistant to their engineer, who is engaged in carrying out the permanent way engineering work. See our "Official Notices" this week.

The Lancaster Electricity Committee wants an electrical engineer at £200 per annum. See our "Official Notices."

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**Wireless Telegraphy.**—The success of the Marconi system between the South Foreland and the East Goodwin lightship seems to be maintained. The *Times* remarks that every day last week operators were at work, and remarkably good results were obtained. Some of the replies are said to have been received almost as quickly as by conversation. The working is not affected by stormy weather. The Elder Brethren of the Trinity House are expected to shortly witness the experiments.

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**Röntgen Rays in 1898.**—In the course of its "Review of Science in 1898," the *Times* remarks that the year witnessed great improvements in the technique of radiography or Röntgen photography, especially in the direction of making it stereoscopic. The opening of the Thomson-Yates laboratories at University College, Liverpool, was an event of much interest to physiologists, inasmuch as their completion and equipment is an indication that private generosity will often carry out what communities and Goverments fail to support. The laboratories under Prof. Sherrington's care are probably the finest in this country, and regarded from the standpoint of convenience of mechanical appliances, electricity, &c., are equal to the most renowned on the Continent.

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**The Running Away of Inverted Converters.**—In a recent article in the *Electrical World*, Mr. C. P. Steinmetz pointed out that the rotary converter, when used to transfer power from direct current to alternating current circuits, is likely to have its field strength greatly weakened by lagging currents in the latter, in which case the machine will, of course, tend to run away as a direct current motor. A simple way of avoiding this contingency is the excitation of the converter fields by a separate exciter driven either mechanically by the converter, or by an alternating current motor supplied therefrom. In case the converter tends to speed up, due to reduced field strength, the speed, and consequently the voltage of the exciter, rises, restoring the field magnetisation of the converter, and limiting the speed variation. The same steadying effect takes place in the less frequent and less dangerous case of leading currents and reduced speed.

**Lectures.**—Before the Bradford Scientific Association on 20th inst., Mr. H. B. Knowles lectured on "Electric Traction."

Before the Royal Dublin Society on 18th inst, Sir Howard Grubb, vice-president, read a paper on "A Proposal for the Utilisation of the Marconi System of Wireless Telegraphy for the Control of Public and other Clocks."

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**Heating Water by Live Steam.**—Some correspondence appears in the *Practical Engineer* which throws strong doubts upon the alleged economy of live steam feed heating. While not doubting the beneficial effect on the boilers, doubts are expressed as to the principle. Mr. Dalrymple is quoted in respect of some six examples, which show no benefit from the Kirkaldy heater. Some are given with figures, and another firm of engineers is cited to the same effect, although better steaming is admitted to be obtained in some cases, and, of course, the benefit to the boiler as a structure is undoubted. Boilers also behave better, says Mr. Dalrymple, and "look more refined" internally when examined, which last is credible. The firm mentioned as corroborating Mr. Dalrymple are stated to be makers of all kinds of feed heaters, so are probably, if at all, biased in favour of the heating claim for economy.

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**Electric Lighting at Windsor Castle.**—The *Daily Chronicle* says that the Windsor Electric Installation Company has been directed to lay a cable from the works in Peascod Street to Windsor Castle in order to supply the current for the palace, which has hitherto been generated at the station under the north terrace opposite the Royal library. The cable will be carried up Castle Hill to the grand quadrangle, and will be capable of lighting about 2,000 lamps. The work, it is understood, will be completed before the Queen's return from Osborne.

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**Electric Lighting of the National History Museum.**—Prof. E. Ray Lancaster, director of the Natural History Department of the British Museum, writes to the *Times*, saying that arrangements have been made by the trustees for the supply of electric lighting to this museum, and only a few weeks ago the Treasury gave assent to the necessary expenditure. The electric light will be gradually introduced into the various parts of this large building—first of all into the offices and studies of the staff and the workshops in the basement, then into the various public galleries.

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**The L.C.C. Tramways Manager.**—It is announced that Mr. Baker may be expected to permanently take up his position as tramways manager to the L.C.C. on February 1st. The Nottingham Town Council has arranged to permit him to spend part of his time previous to that date upon any matters in connection with the London trams which may require immediate attention. The L.C.C. is contemplating inaugurating an all-night tram service, as is being done by certain companies, but this will not be introduced until the third week in February.

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**The Southampton Shock Fatality.**—We have received a copy of Major Cardew's report upon the fatal accident from electric shock which occurred at Southampton on December 12th.

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**Personal.**—We are informed that Mr. E. C. Rimington has recently taken over the testing and consulting work formerly carried on by Messrs. Harrison & O'Brien at 19 and 21, Queen Victoria Street, E.C. Mr. Rimington is making a speciality of investigating and reporting on new inventions and apparatus, the standardising of high-grade instruments (especially for alternating work), the determining of efficiency of lamps and accumulators, and exact testing of transformer iron, insulating materials, &c., for manufacturing firms. For these purposes the laboratory at the above address is well furnished with complete sets of special instruments; and the well-known ability of Mr. Rimington, who will be remembered by many former pupils as senior lecturer at the School of Electrical Engineering, Hanover Square, as well as for his experimental work and frequent contributions to technical literature, will offer a guarantee that work entrusted to him will be efficiently carried out.

**Liquid Hydrogen.**—At the Royal Institution last Friday Prof. Dewar gave before a large audience a discourse on "Liquid Hydrogen." He referred to the work of other experimenters, and his own investigations which led to the construction of the present apparatus, from which, with the aid of an improvement in the means of collection from the vacuum tube, he had obtained hydrogen as a static liquid. When pure it was a colourless, transparent liquid, possessing considerable refractive power. It had a well-defined meniscus but no appearance of being a metal, as Faraday thought it might prove to be. It was not a conductor of electricity. Its density was very deceptive. At first he thought it might be about half that of water, but, on determining it by the method of measuring a given volume and seeing how much gas it produced, he found it to be only $\frac{1}{14}$th that of water, or six times less than that of the lightest liquid hitherto known. One litre weighed only 70 grammes. It instantly froze and solidified air and oxygen, and hence enabled the density of those two solids to be ascertained. A little ball cooled in it and exposed to the air was first covered with a coating of solid air and then began to drip liquid air. A piece of cotton-wool soaked in it appeared magnetic. But the liquid itself, he was satisfied, was not magnetic, so that this phenomenon must be due to the cotton-wool being immediately filled with solid oxygen, which, of course, was highly magnetic. Prof. Dewar next explained how vacua of very high tenuity could be easily and simply obtained by immersing a closed tube in the liquid. He also, according to a report in the *Times*, gave some details about its physical constants, and concluded by explaining the method of measuring its temperature by means of a platinum resistance thermometer. It was found impossible to show liquid air to the audience, owing to the great difficulty of its manufacture, the reason being the impossibility in spite of all precautions of keeping the hydrogen perfectly free from air. If the least trace of air gets in it freezes solid, and, accumulating in the nozzle where the liquid appears, absolutely stops the working of the apparatus.

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**"Past their Best" at Thirty.**—Respecting the decision of Brunner, Mond & Co., the great chemical manufacturers, not to engage any new men above 30 years of age, Sir John Brunner, on Tuesday, said at Northwich that the firm's trade had been reduced by the enormous taxation upon alkali in America, and as they had decided to give a limited weekly amount to all who had served them faithfully for a long period, he bitterly regretted that they could not afford to take on men "past their best in life." The Urban Council will endeavour to promote new industries.

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**Prof. Graham Bell.**—The New York *Electrical Engineer* says that Prof. Alexander Graham Bell, the world-renowned inventor of the Bell telephone, arrived at San Francisco on December 27th on the steamship *China*. He has been in the Orient for three months, during which time he travelled for several weeks in Japan. Prof. Bell proceeded from San Francisco to his winter residence in the national capital, where he has a large scientific laboratory. At Washington he will immediately read before the National Academy of Sciences a personal memoir dealing with his experiments and extensive observations in aerial navigation. He believes that airships will be successfully operated.

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**Electrical Engineers (R.E.) Volunteers.**—The first smoking concert of the above corps is to be held to-night, at 8 o'clock, at the Holborn Restaurant.

It is stated that the War Office has refused to authorise further promotion of officers in the corps of Electrical Engineer Volunteers until more men are enlisted for the corps.

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## NEW COMPANIES REGISTERED.

**Recording Telegraphs, Limited** (60,307).—This company was registered on January 17th, with a capital of £7,500 in £50 shares, to subscribe for, underwrite, issue, take, hold, deal in and convert stocks, shares, and securities, and to acquire, develop, and turn to account any letters patents, brevets d'invention, &c. The first subscribers (each with one share) are:—R. L. Cowper-Coles, 108, New Oxford Street, W., captain, retired; Walter T. Goolden, Broad Sanctuary Chambers, Westminster, civil engineer; Edward J. Wood, 49, Stanwick Mansions, West Kensington, electrical engineer; John A. Currie, 11 and 12, Clement's Lane, E.C., insurance broker; Edward P. Reynolds, Ashdell Grove, Sheffield, gentleman; C. E. Spagnoletti, 2, Craven Terrace, Ealing, W., electrical engineer; and Ernest E. Cobb, 52, Queen Victoria Street, E.C., secretary. Registered without articles of association.

**Whitmore & Binyon, Limited** (60,328).—This company was registered on January 17th, with a capital of £55,000 in £1 shares (of which 10,000 are 5½ per cent. cumulative preference) to acquire and take over as a going concern the business now carried on at Wickham Market, Suffolk, and at 64, Mark Lane, E.C, under the style of "Whitmore & Binyon," and to carry on the business of engineers, millwrights, manufacturers of engines, machinery, boilers and fittings, iron and steel founders, electricians, manufacturers of electrical apparatus and plant, miners, metallurgists, colliery owners, shipbuilders, &c. The first subscribers (each with one share) are:—W. N. Whitmore, Wickham Market, engineer; G. Binyon, 64, Mark Lane, E.C., engineer; W. J. Perrett, Romford, engineer; W. J. Whitmore, Wickham Market, engineer; C. W. Sutton, Ipswich, manufacturing chemist; N. Suffling, Albert Square, Great Yarmouth, auctioneer; and W. Dyer, Regent Road, Great Yarmouth, gentleman. The number of directors is not to be less than three nor more than five; the first are William N. Whitmore, George Binyon, Walter J. Perrett, and William J. Whitmore; qualification, £250; remuneration as the company may decide.

**Giffre Electro-Chemical and Power Company, Limited** (60,340).—This company was registered on January 18th, with a capital of £140,000 in £1 shares, to acquire all or any of the capital, stock, shares, debentures, obligations or securities of a French company called the "Société Electro-chimique du Giffre," to enter into an agreement with the "General Water Power, Limited," to work, develop, turn to account and manufacture any articles in accordance with any chemical, electrical or electro-chemical process, to manufacture, sell, deal in, import and export calcium carbide, and to carry on the business of chemists, druggists, drysalters and manufacturers of, and dealers in, chemical, industrial and other preparations. The first subscribers (each with one share) are:—Christopher F. A. Spashett, Lansdowne, Heathfield Road, West Hampstead, registrar; Joseph A. Marrot, 30, South Eaton Place, S.W., gentleman; Waldemar H. Ostertag, 22, Church Road, Richmond, S.W., secretary; Arthur E. Philp, Frogmore House, Jamaica Road, S.E., accountant; Percy H. Hetherington, 62, Jeffrey's Road, Clapham, S.W., clerk; Adolphe Lucas, 97, St. Mark's Road, North Kensington, W., clerk; and Frederick W. Allen, 7, Hartismere Road, Walham Green, S.W., accountant. The number of directors is not to be less than three nor more than five; the first are W. H. Grenfell, John Paddon and Ernest E. Sawyer; qualification, £500; remuneration, £500 per annum, and a percentage of the profits divided between them. Registered office, 11, Cornhill, E.C.

**Hazardous and General Merchandise Carrying Company, Limited** (60,349).—This company was registered on January 19th, with a capital of £150,000 in £1 shares (of which 75,000 are 6 per cent. cumulative preference), to carry on the business of proprietors of vans, waggons, carriages, and other vehicles, jobmasters, carriers of passengers and goods, carpenters, joiners, electricians, mechanical engineers, machinists, rubber manufacturers and merchants, workers and dealers in mineral oils, motive power, traction, light and heat; to construct, purchase, equip, maintain, work and sell and deal with vans, carriages and waggons, and to generate, accumulate, and supply electricity. The first subscribers are:—George W. Hargreave, 92, Lexham Gardens, Kensington, W., lieutenant-colonel, 450 shares; George Edwards, 34, Coolhurst Road, Crouch End, N., gentleman, 50 shares; Walter E. King, 26, Birchin Lane, E.C., shipbroker, 50 shares; John M. Barnes, White House, Ifield, Crawley, Sussex, gentleman, 50 shares; Charles A. M. Press, Albert Villa, Norbiton, S.W., 50 shares; David Amey, 4, Margery Park Road, Forest Gate, E., 10 shares; and William W. Simpson, 5, Carlton Hill, N.W., accountant, 200 shares. The number of directors is not to be less than three nor more than seven; the first are to be nominated by the subscribers; qualification, 200 shares; remuneration, £150 each per annum, and an extra £100 for the chairman.

**Rubber and Vulcanite Company, Limited** (60,374).—This company was registered on January 20th, with a capital of £12,500 in £1 shares (of which 3,500 are preference, 6,500 ordinary, and 2,500 as the directors may decide), to manufacture, sell, and deal in rubber, gutta-percha, vulcanite, and similar substances and articles manufactured therefrom, and to produce and use electricity, magnetism, or other power. The subscribers (each with one share) are:—H. J. Baker, 41, Burnfoot Avenue, Fulham, clerk; F. A. Venning, 75, Lady Margaret Road, N.W., manager; H. M. Simpson, 49, Dalberg Road, Herne Hill, S.E., clerk; A. B. Mayhew, 10, Old Broad Street, E.C., journalist; T. M. Loomes, 105, Clapham Road, S.W., clerk; Charles A. Shoobridge, 33, Old Broad Street, E.C, clerk; and J. W. Wilby, 33, Glenwood Road, Catford, S.E., accountant. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £100; remuneration, £300 per annum divided between them.

**Suspended Electric Railway Company, Limited** (60,378).—This company was registered on January 20th, with a capital of £60,000 in £1 shares, to enter into an agreement with Christian de Thal and Romain Weiss, to construct, equip, improve, develop, maintain, and manage or work by electricity and any other mechanical power any railways, tramways, motor cars, or other vehicles, and to carry on the business of railway, tramway, and motor

car proprietors, carriers of passengers and goods, suppliers of electricity, manufacturers of, and dealers in, carriages, trucks, locomotives, accumulators, and dynamos, builders, contractors, engineers, &c. The first subscribers (each with one share) are:—Christian de Thal, 32, Moika, St. Petersburg, Russian nobleman; Romain Weiss, Surisnes, France, engineer; John Gaskell, 122, Queen's Gate, S.W., gentleman; Ernest C. Fowler, Gordon House, Ham Common, Surrey, gentleman; James W. Jenner, 34, Millbank Street, S.W., clerk; James Cunningham, 19, Carden Street, Pimlico, S.W., secretary; and Edward Hinton, 32, Victoria Street, S.W., buyer. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; remuneration, £100 each per annum (an extra £50 for the chairman) and a share in the profits. Registered office, 28, Victoria Street, Westminster.

**Mather & Platt, Limited** (60,387).—This company was registered on January 21st, with a capital of £775,000 in £10 shares (of which 37,500 are 5 per cent. cumulative preference), to acquire and take over as going concerns the businesses of Mather and Platt, Limited (incorporated in 1892) and Dowson, Taylor & Co., Limited, to enter into agreements (1) with William Mather and (2) with Dowson, Taylor & Co., Limited, and to carry on the business of mechanical, electrical, hydraulic, and general engineers, machinists, tool makers, boiler makers, steel, iron, and brass founders, metal workers, millwrights, electricians, iron and steel converters, smiths, metallurgists, &c. The first subscribers (each with one share) are:—William Mather, Salford Iron Works, Manchester, engineer: John Platt, Salford Iron Works, Manchester, engineer; Edward Hopkinson, Salford Iron Works, Manchester, engineer; John Taylor, Blackfriars Bridge, Manchester, engineer; John Wormald, 14, Victoria Street, Westminster, engineer; Colin Mather, Salford Iron Works, Manchester, engineer; and John J. Holden, 73, Albert Road, Southport, cotton spinner. The first directors (to number not less than five nor more than 11) are William Mather (chairman), John Platt, Edward Hopkinson, John Taylor, Colin Mather, John Milligan, Hardman A. Earle, John Wormald, J. J. Holden, W. Ernest Mather, and Alfred Willett: qualification, 100 shares; remuneration, £1,500 per annum, divided between them. Registered office, Salford Iron Works, Salford, Manchester.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Automatic Telephone Company, Limited** (53,157).—This company's annual return was filed on January 16th, when 314,326 shares were taken up out of a capital of £100,000 in 5s. shares, 270,296 are considered as paid, and 4s. per share has been called on 17,620, and 1s. per share on 26,410; £5,215 8s. has been paid, and £302 2s. is in arrears.

**Hampstead Electric Supply Company, Limited** (58,293).—This company's statutory return was filed on January 13th. The capital is £200,000 in £5 shares (20,000 preference). 12,589 shares have been taken up, £5 per share has been called, and £58,647 12s. 4d. has been received, leaving £4,297 7s. 8d. unpaid.

**Smithfield Markets Electric Supply Company, Limited** (53,354).—This company's annual return was filed on January 12th, when 12,000 shares were taken up out of a capital of £100,000 in £5 shares, and paid for in full.

## CITY NOTES.

### The Direct United States Cable Company, Limited.

THE directors' report for the six months ended December 31st, 1898, to be presented at the meeting to be held at Winchester House, on Tuesday, January 31st, 1899, at 2 o'clock p.m., says that the half-year's revenue, after deducting out-payments, amounted to £54,366 4s. 10d. as compared with £50,098 2s. 8d. for the corresponding period of 1897, showing a difference of £4,268 2s. 2d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, amounted to £21,620 19s. 11d., leaving a balance of £32,745 4s. 11d. as the net profit, making with £3,388 11s. 9d. brought forward from the previous half-year a total of £36,133 16s. 8d. For the corresponding period of 1897, the working expenses and other payments amounted to £19,722 13s. 10d. Interim dividends of 3s. per share for the quarter ended September 30th, 1898 (paid October 24th, 1898), and of 3s. per share for the quarter ended December 31st, 1898 (payable January 31st, 1899), together amounting to £18,213, have been declared, and after setting aside £12,000 to the reserve fund account, the balance of £5,920 16s. 8d. on the revenue account has been carried forward. No repairs of the cables have been necessary during the half-year. The reserve fund account has been debited with £1,548 0s. 2d., being the balance of the Ballinskelligs Buildings and Rye Beach land accounts now written off, and after being credited with interest, realised profit and sum transferred from revenue account, the balance of the reserve fund, taking the investments at cost price, now amounts to £368,534 1s. 7d.

### City and South London Railway Company.

THE report of the directors for the half-year ending December 31st, 1898, to be submitted to the half-yearly ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, in the City of London, on Tuesday, January 31st, 1899, at 12 o'clock noon, states that the receipts from all sources for the past half-year have amounted to £27,588 9s. 4d., and the cost of working has been £15,498 5s. 7d., leaving a profit of £12,090 3s. 9d. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £13,171 0s. 8d. After making provision for the debenture stock interest, a balance remains available for dividend of £10,190 12s. 9d. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 2 per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £1,419 12s. 6d. to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried since the opening of the railway in each half-year:—

| Half-year ended | Number of passengers (exclusive of season ticket holders). | Receipts (including season tickets). |
|---|---|---|
| | | £ s. d. |
| December 31st, 1890 (11 days)... | 165,000 | 1 568 3 9 |
| June 30th, 1891 ... ... | 2,412,343 | 19 403 6 9 |
| December 31st, 1891 ... ... | 2,749,055 | 19 798 16 6 |
| June 30th, 1892 ... ... | 2,813,162 | 20,931 4 2 |
| December 31st, 1892 ... ... | 3,117,602 | 22,002 17 5 |
| June 30th, 1893 ... ... | 3,146,656 | 22,458 6 9 |
| December 31st, 1893 ... ... | 3,093,351 | 22,067 14 10 |
| June 30th, 1894 ... ... | 3,383,154 | 23,564 10 6 |
| December 31st, 1894 ... ... | 3,275,649 | 23,540 12 4 |
| June 30th, 1895 ... ... | 3,113,199 | 23,711 5 8 |
| December 31st, 1895 ... ... | 3,172,438 | 23,780 3 7 |
| June 30th, 1896 ... ... | 3,192,672 | 24,021 13 0 |
| December 31st, 1896 ... ... | 3,368,480 | 25,456 6 9 |
| June 30th, 1897... ... ... | 3,437,810 | 26 403 3 6 |
| December 31st, 1897 ... ... | 3,337,861 | 25,472 12 10 |
| June 30th, 1898... ... ... | 3,478,977 | 26,356 16 4 |
| December 31st, 1898 ... ... | 3,462,814 | 26,319 14 10 |
| Total since the opening of the line | 50,720,223 | £376,857 9 6 |

Taking into consideration the abnormally fine weather during the summer and autumn months, and the extreme mildness of the latter part of the half-year, the directors feel justified in congratulating the proprietors on the increase in the traffic over the corresponding period last year, both in the number of passengers carried and in the amount of receipts. The progress with the Moorgate Street extension has been uninterrupted; both tunnels are completed from the junction with the present line at the Borough to Moorgate Street Station and the three underground stations are almost finished. The shafts are ready for the lifts, the erection of which has already been commenced. The laying of the permanent way is also well advanced, and the subway communication between the Lombard Street Station of this company and the Bank Station of the Central London has been constructed. The station buildings on the surface at Moorgate Street, Lombard Street, and London Bridge will be commenced forthwith. The works of the extension from Stockwell to Clapham Common are progressing very satisfactorily, and it is anticipated that the line will be completed ready for traffic early in the autumn of this year. The erection of the new boiler and engine house at the depôt at Stockwell is proceeding rapidly, and will be ready for the erection of the engines in March. The three locomotives referred to in the last report have been delivered, and, as their working has given satisfaction, tenders for the full number required are now being invited. The 30 additional coaches required are now in course of delivery. The works of the extension through the heart of the City having now been completed, it is necessary, in order to utilise fully this valuable portion of the line, that the remainder of the authorised undertaking, carrying the line to the Angel at Islington and thus bringing in the traffic from the North as well as from the South, should at once be proceeded with, and steps have already been taken to secure the site of one of the three stations along the route. It is proposed to let the contract for the works as soon as favourable arrangements can be made. It is anticipated that this portion of the railway will be constructed at a very moderate cost, and can be worked economically with power supplied from the generating station at Stockwell. Negotiations are in progress with the London, Brighton and South Coast Railway Company for the construction of the subway authorised by the Act of 1893 connecting this company's new station at Denman Street with the London Bridge Station of the Brighton Company. In order to further facilitate and economise the working of the City and Brixton Railway, which, when completed, is to be leased to this company under the agreement sanctioned by the proprietors in February last, it has been arranged that, in lieu of providing a separate depôt for the Brixton company, a short tunnel should be made connecting that company's line with this company's depôt at Stockwell. A Bill has been introduced into Parliament with this object; and, as some modification of the agreement will be necessary, a special meeting of the company will be held as soon as the new agreement is finally settled, that it may be submitted to the proprietors for their approval. Pending these arrangements the construction of the City and Brixton railway has not yet been proceeded with.

## Eastern Telegraph Company, Limited.

THE half-yearly meeting of the shareholders of this company was held on Thursday last week at Winchester House, Old Broad Street, the Marquis of Tweeddale in the chair.

The CHAIRMAN, in moving the adoption of the report, said the gross revenue for the half-year under review had amounted to £441,011, an increase of £284 over the corresponding period of 1897. They would probably remember that in the September half of 1897 they derived extra traffic from Crete owing to the disturbed condition of the island, but the traffic there had since resumed its normal condition. The ordinary expenses for the half-year had amounted to £121,376, or an increase of £12,133. That increase comprised several items of an exceptional character, which did not appear in the corresponding period, and which would not recur. The duty on the new capital which was issued with the sanction of the shareholders, cost £2,000; and expenses in connection with the conversion of shares and the issue of new stock came to £662. Then there was an item under the head of negotiations with foreign Governments amounting to £3,942, which appeared for the first time. That item related to expenses which had been incurred in connection with the businesses which they had in hand, and the nature of which would be intimated to the shareholders when the negotiations had come to a conclusion. Then there was a gift of £26 to the West Indies Relief Fund, which gave a total of £6,630 of what might be described as extraordinary expenses. The increase therefore in the ordinary expenses might be put at £5,503. The nature of that increase was fully explained at the last meeting, and was due to the introduction of an automatic system of signalling, necessitating additions to the staff, and also to the cost of improved electrical appliances, together with the various expenses incidental to an increased number of employés. If they compared the present figures with those submitted at the last meeting, it would be seen that if they deducted the exceptional expenses the increase was comparatively small. He must, however, remind them that their expenses had a tendency to increase in a greater ratio than the revenue. They must always bear in mind that a company such as theirs existed for the benefit of the public as well as for that of the shareholders, and therefore they had spent, and would continue to spend, large sums of money in improving the efficiency of the service, in increasing the number of their cables, and by the introduction of the most modern plant and electrical appliances, and by dealing liberally with their staff. Again, they had from time to time made extensive and might still make further reductions in their charges. All that entailed considerable expense, while the lowering of the rates, though generally followed by a greater volume of traffic, did not always ensure an increase in the revenue, in fact, not infrequently the contrary was the case. It was only, therefore, by the exercise of strict and judicious economy, consistent with efficiency, that their working expenses could be kept within proper limits. The general expenses in London during the half-year under review had amounted to £12,875, or a decrease of £49, while the working expenses at stations showed an increase of £2,328. There was also an increase under the head of electrical instruments, stationery, printing, &c., but a decrease under several other headings. The expenses attending repairs and renewal of cables were £41,716, or an increase of £10,079; and there was an increase of £2,571 in the actual cost of ships' expenses. The amounts received from Governments and other companies for repairs was £7,172 less. The net result of the half-year was that they had to carry £5,000 less to the general reserve fund, £15,000 less to the minor reserves, and £6,500 less forward to the next account. Notwithstanding these reductions, he thought, after the explanations he had given, they would consider the result of the half-year's working highly satisfactory. He was glad to be able to add that the receipts, as far as they had gone this current half-year, had been fully maintained. Since the report was issued, he was glad to say that the new cable between Porthcurnow and Malta and Alexandria was nearly completed, and when that was done, telegraphic communication between Great Britain and Egypt and the Far East would be greatly improved.

MR. J. DENISON PENDER seconded the motion, and the report was adopted.

## New Issues.

MATHER & PLATT, LIMITED, has been formed to acquire and unite the businesses carried on by the private companies of Mather and Platt, Limited, Salford Iron Works, Manchester, and Messrs. Dowson, Taylor & Co., of Manchester, fire engineers, who are the sole manufacturers of the "Grinnell" sprinkler for the automatic extinction of fires. It is hardly necessary to emphasise the important position occupied by Messrs. Mather & Platt in the engineering world; in electrical work the company has achieved considerable distinction, and ought to secure a considerable share of future contracts for lighting and power plant. The capital is £775,000, divided into 37,500 5 per cent. cumulative preference shares of £10 each (to be issued at a premium of 10s. per share), £375,000; 40,000 ordinary shares of £10 each, £400,000.

The prospectus states that the preference shares are entitled to a cumulative preference dividend of £5 per cent. per annum, and upon a distribution of assets, to have the capital paid up thereon, with a premium of 10s. per share, repaid in priority to the ordinary shares, but are not entitled to participate in further surplus assets.

The premium upon the present issue is to constitute a nucleus of a reserve fund, available for the purposes of the company.

5,000 preference shares are reserved for issue as and when required for future extensions of the business.

37,500 of the ordinary shares, and 10,800 of the preference shares (the latter being approximately one-third of the preference shares now issued) are to be issued as fully paid in part consideration for sale of the above businesses.

The remaining 2,500 ordinary shares are reserved for applications from certain employés of the company.

The balance, 21,700 5 per cent. cumulative preference shares, are now offered for subscription at £10 10s., payable as follows:—On application, £1 per share; on allotment, £4 10s. per share (of which 10s. is the premium); on March 25th, 1899, £5 per share—£10 10s.

Dividends on the preference shares will be payable half-yearly, on September 1st and March 1st, and the first dividend will be paid September 1st, 1899, and will be calculated from the dates of the instalments to June 30th, 1899.

No promotion money has been or will be paid, and none of the shares have been underwritten.

It is rumoured that the above shares were subscribed about six times over before the list opened.

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The General Water Power, Limited, has been inviting subscriptions for shares of the Giffre Electro-Chemical and Power Company, Limited. The authorised capital is £140,000 in £1 shares, and the present issue to the public is 110,000 shares. The company has been formed to purchase all the shares of a French company, the Société Electro-Chemique du Giffre, carrying on business in Haute Savoie, France. The directors of the new company are Messrs. E. E. Sawyer, M.I.C.E., W. H. Grenfell, and John Paddon. The secretary (*pro. tem.*) is Mr. J. Aug. Marrot, 11, Cornhill, E.C. The list closed yesterday for town and to-day for the country.

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**Anglo-American Telegraph Company, Limited.**—The directors have resolved, after placing the sum of £12,000 to the credit of the renewed fund for the half-year, to recommend at the next ordinary general meeting on February 3rd the declaration of the following dividends:—1. A balance dividend of £1 4s. per cent. upon the ordinary consolidated stock for the year ending December 31st, 1898. 2. A balance dividend of £1 10s. per cent. upon the preferred stock for the year ending December 31st, 1898. 3. A first and final dividend of 18s. per cent. upon the deferred stock for the year ending December 31st, 1898, all payable on February 4th next, less income-tax, to the stockholders registered on the books of the company on January 16th. After paying the foregoing dividends there will be a balance of about £580 to be carried forward to the next account. The above dividends together with those already paid will amount to £3 9s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and 18s. per cent. on the deferred stock for the year 1898. The register of transfers will be closed from January 20th to February 3rd, both days inclusive.

**The Liverpool Overhead Railway Company, Limited.**—The accounts just issued for the last half-year show an available balance of £16,586, out of which the directors propose to pay a dividend at the rate of 5 per cent. upon the preference shares, and 4 per cent. upon the ordinary shares, leaving a balance of £4,586 to be carried forward. The distribution of the ordinary shares this time last year was only at the rate of 3½ per cent. per annum.

**St. James's and Pall Mall Electric Light Company, Limited.**—The directors recommend a dividend for the half-year ending December 31st of 7s. 6d., together with a bonus of 2s. per share on the ordinary shares, making, with the interim, a dividend of 12½ per cent. and a bonus of 2 per cent. for the year 1898.

**Waterloo and City Railway Company.**—The directors have resolved to recommend a dividend on the ordinary stock at the rate of 3 per cent. per annum for the full half-year ended December 31st last.

**National Telephone Company.**—The directors have declared a dividend of 6 per cent. on ordinary shares, added £50,000 to reserve, and carried £8,000 forward.

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## TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending January 21st, 1899, were £129 17s. 2d.; aggregate to date, £410 2s. 2d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending January 20th, 1899, were £2,578 11s. 8d.; corresponding period, 1898, £2,380 10s. 11d.; increase, £198 0s. 9d.

The City and South London Railway Company.—The receipts for the week ending January 22nd, 1899, were £1,133; week ending January 23rd, 1898, £1,075; increase, £58; total receipts for half-year, 1899, £4,419; corresponding period, 1898, £4,334; increase, £85. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending January 21st, 1899, were £148 5s. 9d.; week ending January 22nd, 1898, £107 17s. 6d.; increase, £40 8s. 3d. Total receipts to date, 1899, £454 13s. 11d.; corresponding period, 1898, £333 12s. 8d.; increase, £121 1s. 3d. Miles of track open week ending January 21st, 1899, 3; week ending January 22nd, 1898, 3. Car miles run week ending January 21st, 1899, 4,172; week ending January 22nd, 1898, 2,793. Number of cars week ending January 21st, 1899, 11; week ending January 22nd, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, January 20th, 1899, were as follows:—D. U. T. Co., horse cars, £2,076 2s.; ditto, electric cars, £582 13s. 8d.; D. S. D. Co., electric cars, £634 8s. 3d.; total, £3,293 3s. 11d; corresponding week last year—D. U. T. Co., horse cars, £2 677 12s. 10d.; ditto, electric cars, £122 5s. 4d.; D. S. D. Co., electric cars, £455 17s.; total, £3,255 15s. 2d.; increase, £37 8s. 9d; aggregate to date, £9,185 5s. 4d.; ditto last year, £9,348 17s. 1d.; decrease to date, £163 11s. 9d. Worked:—The mileage open is 16 miles electrically, 28 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending January 22nd, 1899, amounted to £1,326: corresponding week last year, £1,354; decrease, £28.

The South Staffordshire Tramways Company.—The receipts for week ending January 20th, 1899, were £679 1s. 2d.; aggregate receipts for three weeks, £1,765 17s. 4d.; week ending January 21st, 1898, £634 2s. 6d.; aggregate receipts for three weeks, £1,785 3s. 9d.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation, Jan. 18th. | Closing Quotation, Jan. 25th. | Business done during week ended Jan. 25th, 1899. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 124,400£ | African Direct Telegraph, 4 % Debs. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 25,000 | Amazon Telegraph, shares | 10 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 125,000 | Do. do. 5 % Debs. Red. | 100 | ... | ... | ... | 91 — 94 | 87 — 92 | ... | ... |
| 905,560£ | Anglo-American Telegraph | Stock | £2 13s | 3 % | £3 9s | 67 — 69 | 67 — 69 | 67½ | ... |
| 3,047,220£ | Do. do. 6 % Pref. | Stock | £5 6s | 6 % | 6 % | 118½—119½ | 119½—120½ | 120½ | 119½ |
| 3,047,220£ | Do. do. Deferred | Stock | ... | ... | 18s. % | 16½— 17 | 16½— 17 | 17 | 16⅝ |
| 130,000 | Brazilian Submarine Telegraph | 10 | 7 % | 7 % | ... | 15½— 15⅝ | 15⅝— 16½ | 16¼ | 15⅝ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 4 % | 4 % | ... | 2¾— 3¼ | 2¾— 3¼ | ... | ... |
| 10,000,000$ | Commercial Cable | $100 | 8 % | 8 % | ... | 180 —190 | 180 —190 | ... | ... |
| 1,332,523£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 103 —105 | 104 —106 | 104⅞ | 104½ |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 2 % | ... | ... | 1/16— 3/16 | 1/16— 3/16 | ... | ... |
| 16,000 | Cuba Telegraph | 10 | 8 % | 7 % | ... | 9½— 10½ | 9½— 10½ | 9⅜ | ... |
| 6,000 | Do. 10 % Pref. | 10 | 10 % | 10 % | ... | 17 — 18 | 17 — 18 | ... | ... |
| 12,931 | Direct Spanish Telegraph | 5 | 4 % | 4 % | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | 10 % | 10 % | ... | 10 — 11 | 10 — 11 | ... | ... |
| 30,000£ | Do. do. 4½ % Debs., Nos. 1 to 6,000 | 50 | 4½ % | 4½ % | ... | 104 —107% | 104 —107% | ... | ... |
| 60,710£ | Direct United States Cable | 20 | 2½ % | ... | ... | 11¾— 12¼ | 12 — 12½ | 12 5/16 | 12⅛ |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | ... | ... | ... | 174 —179 xd | 174 —179 | 178 | 176½ |
| 1,295,000 | Do. 3½% Pref. Stock | 100 | ... | ... | ... | 103 —106 xd | 103 —106 | 105½ | 103 |
| 500,000 | Do. Prov. Certs., all paid | ... | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 89,900 | Do. 5 % Debs., repayable August, 1899 | 100 | 5 % | 5 % | ... | 101 —104 | 101 —104 | ... | ... |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. | Stock | 4 % | 4 % | ... | 124 —128 | 125 —129 | 127 | 126 |
| 250,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | ... | 17½— 18 xd | 17½— 18 | 17¾ | 17⅝ |
| 16,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | 5 % | ... | 99 —103 | 99 —103 | ... | ... |
| 64,400£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | 5 % | ... | 100 —103 | 100 —103 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock | Stock | 4 % | 4 % | ... | 125 —129 | 126 —130 | 129 | ... |
| 35,100£ | Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | ... | ... | 99 —103 | 99 —103 | 100½ | ... |
| 46,500£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 300,000£ | Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909 | 100 | 4 % | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | 4 % | ... | ... | 104 —107% | 104 —107% | ... | ... |
| 180,227 | Globe Telegraph and Trust | 10 | 4½ % | 4½ % | ... | 12¼— 12⅝ | 12½— 13 | 13 | 12⅝ |
| 180,042 | Do. do. 6 % Pref. | 10 | 6 % | 6 % | ... | 16¾— 17½ | 16¾— 17½ | 16⅞ | ... |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 10 % | 10 % | ... | 28½— 29½ | 28½— 29½ | ... | ... |
| 150,000£ | Do. do. do. 5 % Debs. | 100 | 5 % | 5 % | ... | 101 —104 | 101 —104 | 101½ | ... |
| 97,800 | Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd. | 100 | ... | ... | ... | 100 —103 | 99 —102 | 99 | ... |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10 % | ... | 57 — 60 | 57 — 60 | 59 | 58 |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | 6 % | 6 % | ... | 109 —112 | 109 —112 | ... | ... |
| 484,597 | National Telephone, 1 to 484,597 | 5 | 5½ % | 6 % | ... | 5¾— 6 | 5¾— 6 | 5 15/16 | 5 13/16 |
| 15,000 | Do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | ... | 14 — 16 | 14 — 16 | 15¾ | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | ... | 13 — 15 | 13 — 15 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | ... | 5½— 5¾ | 5½— 5¾ | 5¾ | 5 11/16 |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. | Stock | 3½ % | 3½ % | ... | 99 —102 | 99 —102 | 100¼ | ... |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | ... | ⅝— ¾ | ⅝— ¾ | ⅝ | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | ... | 104 —107 | 104 —107 | ... | ... |
| 11,839 | Reuter's | 8 | 5 % | 5 % | ... | 6½— 7½ | 6½— 7½ | ... | ... |
| 3,381 | Submarine Cables Trust | Cert. | ... | ... | ... | 134 —139 | 136 —141 | ... | ... |
| 58,000 | United River Plate Telephone | 5 | 5 % | 6 % | ... | 4¾— 5¼ | 4¾— 5¼ | ... | ... |
| 151,733£ | Do. do. 5 % Debs. | Stock | ... | ... | ... | 103 —106 | 103 —106 | 103½ | ... |
| 200,000£ | West African Telegraph, 5 % Debs. | 100 | 5 % | 5 % | ... | 100 —103 | 100 —103 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ½— 1 | ½— 1 | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel. | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 64,269 | Western and Brazilian Telegraph | 15 | 2 % | 3¼ % | ... | 12¼— 12⅝ | 12¼— 12⅝ | ... | ... |
| 33,129 | Do. do. do. 5 % Pref. Ord. | 7½ | 5 % | 5 % | ... | 8 — 8½ | 8 — 8½ | ... | ... |
| 33,129 | Do. do. do. Def. Ord. | 7½ | nil | ½ % | ... | 4 — 4½ | 4 — 4½ | ... | ... |
| 389,521 | Do. do. do. 4 % Deb. Stock Red. | Stock | ... | ... | ... | 105 —108 | 105 —108 | ... | ... |
| 88,321 | West India and Panama Telegraph | 10 | 1 % | ⅝ % | ... | 1⅝— 2 | 1⅝— 1⅞ | 1⅞ | 1¾ |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | ... | 10¼— 10¾ | 10¼— 10¾ | 10 7/16 | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | ... | 9 — 10 | 9 — 10 | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | 5 % | ... | 104 —107 | 104 —107 | ... | ... |
| 158,100£ | Western Union of U.S. Telegraph, 6 % Ster. Bonds | 100 | 6 % | 6 % | ... | 98 —103 | 98 —103 | 97 | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electricity Supply | 5 | 6 % | 7 % | ... | 11½— 12½ | 11 — 12 | 11¾ | 11⅝ |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 6 — 6½ | 6 — 6½ | ... | ... |
| 34,000 | *Chelsea Electricity Supply, Ord., | 5 | 5 % | 6 % | ... | 8½— 9½ | 8½— 9½ | 9 13/16 | ... |
| 60,000 | Do. do. do. % Deb. Stock Red. | Stock | 4½ % | 4½ % | ... | 113 —115 | 113 —115 | ... | ... |
| 50,000 | City of London Electric Lighting rd. 40,001—90,000 | 10 | 7 % | 10 % | ... | 22 — 24 | 23½— 24½ | 24⅛ | 23¾ |
| 10,000 | Do. Ord. Nos. 90,001 to 100,000 | 10 | ... | ... | ... | 21 — 23 | 22 — 24 | 23 | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | ... | 15½— 16½ | 15½— 16½ | 15½ | ... |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | ... | 125 —130 | 125 —130 | 127½ | ... |
| 30,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000 | 10 | nil | nil | ... | 12½— 13½ | 12½— 13½ | 13 3/16 | ... |
| 10,000 | Do. do. do. Nos. 30,001 to 40,000 | 10 | ... | ... | ... | 12 — 13 | 12 — 13 | ... | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | ... | 14½— 15½ | 14½— 15½ | 14⅝ | ... |
| 17,400 | Edmundsons Elec. Corp., Ord. Shares 1—17,400 | 5 | ... | 5 % | ... | 5 — 5½ | 5 — 5½ | 5 5/16 | 5¼ |
| 15,661 | House-to-House Electric Light Supply, Ord., 101 to 15,761 | 5 | ... | 4 % | ... | 9 — 10 | 9 — 10 | 9½ | ... |
| 12,000 | Do. do. 7 % Cum. Pref. | 5 | 7 % | 7 % | ... | 9½— 10½ | 9½— 10½ | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. | 3 | ... | ... | ... | 3 — 3½ | 3½— 4 | 3⅝ | 3⅜ |
| 48,050 | Do. do. do. 6 % Pref. | 5 | ... | ... | ... | 6¼— 6⅝ | 6½— 7 | 6⅞ | 6 7/16 |
| 100,000 | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 102 —104 | 102 —104 | 103½ | ... |
| 62,500 | Metropolitan Electric Supply, 101 to 62,500 | 10 | 5 % | 6 % | ... | 18½— 19½ | 19 — 20 | 19¼ | 18⅝ |
| 22,500 | Do. Nos. 62,501 to 85,000, £4 paid | 10 | ... | ... | ... | 11½— 12⅔ | 12 — 13 | ... | ... |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½ % | 4½ % | ... | 115 —119 | 118 —121 | 118¾ | 118¼ |
| 6,452 | Notting Hill Electric Lighting | 10 | 4 % | 6 % | ... | 17 — 18 | 17 — 18 | ... | ... |
| 31,980 | St. James's and Pall Mall Electric Light, Ord. | 5 | 10½ % | 14½ % | 14½ % | 17 — 18 | 17 — 18 | 17 8/16 | 17 3/16 |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 10 | 9 — 10 | ... | ... |
| 65,000 | South London Electricity Supply, Ord., £3 paid | 5 | ... | ... | ... | 3 — 3¼ | 3 — 3¼ | 3 3/16 | 3 1/16 |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 | 5 | 9 % | 12 % | ... | 16 — 17 | 15½— 16½ | 16 1/16 | 15¾ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation Jan. 18th. | Closing Quotation Jan. 25th. | Business done during week ended Jan. 25th, 1899. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 60,000 | Aluminium "A" shares, Nos. 1—60,000 ... ... ... | 1 | ... | ... | ... | 3¼— 3¾ | 3¼— 3¾ | ... | ... |
| 90,000 | Do. 4½ % 1st Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 94 —100 | 94 —100 | ... | ... |
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | ... | 17 — 18 | 17½— 18½ | 18¼ | 17½ |
| 10,000 | Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.) | 10 | ... | ... | ... | 13 — 13½ | 13½— 14 | 13 11/16 | 13½ |
| 100,000 | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 119 —121 | 119 —121 | 120⅝ | 120½ |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | *nil* | *nil* | ... | 1¾— 2 | 1⅞— 2⅛ | 1 15/16 | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | *nil* | 4 % | ... | 2⅛— 2⅜ | 2⅛— 2⅜ | ... | ... |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 111 —115 | 111 —115 | 113 | 112½ |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 20,000 | Callender's Cable Construction shares, Nos. 1—20,000 ... | 5 | ... | ... | ... | 9½— 10½ | 9½— 10½ | 10¼ | ... |
| 90,000 | Do. do 4½ % 1st Mort. Deb. Stock Red. | Stock | ... | ... | ... | 110 —113 | 110 —113 | ... | ... |
| 35,250 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9¾— 10¼ | 9¾— 10¼ | 10 3/16 | 9 7/8 |
| 178,303 | Do. do. do. £8 paid ... ... | 10 | ... | ... | ... | 7¾— 8¼ | 7¾— 8¼ | 7 15/16 | 7 13/16 |
| 61,033 | Do. do. Pref. half-shares £3 paid ... | ... | ... | ... | ... | 3½— 4 | 3½— 4 | ... | ... |
| 71,447 | Do. do. Def. do. £5 paid ... | ... | ... | ... | ... | 4 — 4½ | 4 — 4½ | 4⅜ | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | 1 1/16 % | 1 1/8 % | 2⅛ % | 68 — 70 | 69 — 71 | 70 | 69 |
| 22,500 | Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd. | 10 | ... | ... | ... | 3½— 4 | 3¼— 4 | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 2¼— 2¾xd | 2½— 3 | ... | ... |
| 82,850 | Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red. | ... | ... | ... | ... | 91 — 96 | 94 — 99 | 96¼ | 95¾ |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 5½ % | 6 % | ... | 2½— 3 | 2½— 3 | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 5½ % | 6 % | ... | 4 — 5 | 4 — 5 | ... | ... |
| 194,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 97 — 99 | 97 — 99 | 98½ | 98 |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 5 % | 6 % | 6 % | 2¼— 2½ | 2¼— 2½ | 2½ | 2⅜ |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000 ... | 2 | 7 % | 7 % | 7 % | 3 — 3½ | 3 — 3½ | ... | ... |
| 140,300 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 103 —105 xd | 103 —105 | 105 | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ¼— ½ | ¼— ½ | ... | ... |
| 67,275 | Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm. | 2 | ... | ... | ... | ¼— ½ | ¼— ½ | ... | ... |
| 9,600*l* | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | 7 % | ... | 10 — 12 | 10 — 12 | ... | ... |
| 12,500 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 10 | 10 % | 12 % | ... | 23½— 24½ | 24 — 25 | 24⅝ | 24½ |
| 3,000 | Do. do. do. 7 % Pref. ... ... | 10 | 7 % | 7 % | ... | 18 — 19 | 18½— 19½ | 19 | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½ % | 4½ % | ... | 110 —115 | 110 —115 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | ... | 21½— 22½ | 22 — 23 | 22⅜ | 22¼ |
| 800,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 102 —106 | 102 —106 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞ % | 3¼ % | 3¼ % | 10 — 10⅛ | 10⅛— 10⅜ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 14¾— 15¼ | 14¾— 15¼ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | ... | 37 — 41 | 37 — 41 | 40 | 39 |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | ... | ... | ... | ... | ... |
| 13,400 | Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ... | 5 | ... | ... | ... | 8¾— 9¼ | 8½— 9 | ... | ... |
| 13,400 | Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000 | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | 5⅝ | ... |
| 540,000*l* | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | ... | ... | 108 —111 | 108 —111 | ... | ... |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—12.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13½—14; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 107—110%. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 8s. to 10s.
Smithfield Market Electric, 4¼—4¾.
*T. Parker, £10 (fully paid), 16¼.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (January 19th, 1899).

### MARKET QUOTATIONS, Wednesday, January 25th.

| CHEMICALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| *a* Acid, Hydrochloric .. .. per cwt. | 5/- | 5/- | .. |
| *a* „ Nitric .. .. .. per cwt. | 22/- | 22/- | .. |
| *a* „ Oxalic .. .. .. per cwt. | 32/- | 32/- | .. |
| *a* „ Sulphuric .. .. .. per cwt. | 5/6 | 5/6 | .. |
| *a* Ammoniac, Sal .. .. .. per cwt. | 37/- | 37/- | .. |
| *a* Ammonia, Muriate (grey) .. per ton | £19 | £19 | .. |
| *a* „ „ (white) .. per ton | £26 | £26 | .. |
| *a* Bleaching powder .. .. per ton | £5 15 | £5 15 | .. |
| *a* Bisulphide of Carbon .. .. per ton | £15 | £15 | .. |
| *a* Borax .. .. .. .. per ton | £16 10 | £16 10 | .. |
| *a* Benzole (90 %) .. .. .. per gal. | 7/- | 7/- | .. |
| *a* „ (50/90 %) .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Copper Sulphate .. .. .. per ton | £21 10 | £20 10 | £1 inc. |
| *a* Lead, Nitrate .. .. .. per ton | £23 | £23 | .. |
| *a* „ White Sugar .. .. per ton | £30 10 | £30 10 | .. |
| *a* „ Peroxide .. .. .. per ton | £27 10 | £27 10 | .. |
| *a* Methylated Spirit .. .. per gal. | 2/9 | 2/9 | .. |
| *a* Naphtha, Solvent (90 % at 160° C.) .. .. .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Potash, Bichromate, in casks .. per lb. | 3¾d. | 3¾d. | .. |
| *a* „ Caustic (75/80 %) .. per ton | £24 | £24 | .. |
| *a* „ Bisulphate .. .. per ton | £35 | £35 | .. |
| *a* Shellac .. .. .. .. per cwt. | 65/- | 65/- | .. |
| *a* Sulphate of Magnesia .. .. per ton | £4 10 | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. per ton | £6 15 | £6 15 | .. |
| *a* „ Recovered .. .. per ton | £5 15 | £5 15 | .. |
| *a* „ Lump .. .. .. per ton | £5 5 | £5 5 | .. |
| *a* Soda, Caustic (white 70 %) .. per ton | £7 10 | £7 10 | .. |
| *a* „ Crystals .. .. .. per ton | £3 | £3 | .. |
| *a* „ Bichromate, casks .. per lb. | 3d. | 3d. | .. |

| METALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| *b* Aluminium Wire, in ton lots .. per ton | £224 | £224 | .. |
| *b* „ Sheet, in ton lots .. per ton | £191 | £191 | .. |
| *c* Brass (rolled metal 2' to 12') basis per lb. | 7¾d. | 7¾d. | ¼d. inc. |
| *c* „ Tube (brazed) .. .. per lb. | 9¾d. | 9¼d. | ¼d. inc. |
| *c* „ Wire, basis .. .. per lb. | 8d. | 7¾d. | ¼d. inc. |
| *f* Ebonite Rod .. .. .. per lb. | 3/- | 3/- | .. |
| *f* „ Sheet .. .. .. per lb. | 5/- | 5/- | .. |
| *g* Copper Bars .. .. .. per ton | £77 | £73 | £4 inc. |
| *g* „ Wire (basis price) .. per lb. | 9d. | 8½d. | ½d. inc. |
| *g* „ Sheet .. .. .. per ton | £77 | £73 | £4 inc. |
| *g* „ Rod .. .. .. per ton | £77 | £73 | £4 inc. |
| *n* German Silver Wire .. .. per lb. | 1/6 | 1/6½ | .. |
| *h* Gutta-percha, fine .. .. per lb. | 6/- | 6/- | only 3 tons obtainable |
| *h* India-rubber, Para fine .. per lb. | 4/1 | 3/11 | 2d. inc. |
| *i* Iron, Charcoal Sheets .. .. per ton | £18 | £18 | .. |
| *i* „ Pig (Cleveland warrants) per ton | 48/8 | 46/4½ | 2/3½ inc. |
| *i* „ Forgings, according to size per ton | From £11 | From £11 | .. |
| *i* „ Scrap, heavy .. .. per ton | 45/- | 45/- | .. |
| *i* „ Wire galvanised No. 8 .. per ton | £8 15 | £8 15 | .. |
| *g* Lead, English Ingot .. .. per ton | £13 10 | £13 15 | 5/- dec. |
| *g* „ „ Sheet .. .. per ton | £14 10 | £14 10 | .. |
| *l* Mica (uncut slabs 8" long) .. per lb. | 6/6 | 6/6 | .. |
| *m* Manganin Wire No. 28 .. .. per lb. | 8/- | 8/- | .. |
| *g* Mercury .. .. .. .. per bottle | £8 | £8 | .. |
| *o* Platinum .. .. .. .. per oz. | £3 1 6 | £3 1 6 | .. |
| *i* Steel, Magnet, acc'd'g to desc'p'n p. ton | From £15 | to £40 | .. |
| *i* Steel, Magnet, in bars .. .. | £58 | £58 | .. |
| *g* Tin, block .. .. .. .. per ton | £113 | £102 10 | £10 10 inc. |
| *g* „ foil .. .. .. .. per lb. | 1/4 | 1/4 | .. |
| *n* „ wire Nos. 1 to 16 .. .. per lb. | 1/6 | 1/5 | 1d. inc. |
| *j* Yarns, Cotton, Single 10lb. bundles pr lb. | 6⅝d. | 6⅝d. | .. |
| *j* „ Flax, 6 or 8 lea... .. per lb. | 4d. | 4d. | .. |
| *j* „ Hemp, 3 ply 10 lbs. .. per lb. | 3½d. | 3½d. | .. |
| *j* „ „ Russian, 10 lbs. per lb. | 4½d. | 4½d. | .. |
| *j* „ Jute, 180 lbs. rove .. per ton | £12 | £12 | .. |
| *j* „ Manila, 24 thread .. per ton | £30 | £30 | .. |
| *k* Zinc, Sheet (Vielle Montagne bnd.) p. t. | £28 10 | £28 | 10/- inc. |

*a* Quotations supplied by Messrs. G. Boor & Co.
*b* „ „ „ The British Aluminium Co., Ltd
*c* „ „ „ Messrs. Thos. Bolton & Sons.
*d* „ „ „
*e* „ „ „
*f* „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
*g* „ „ „ Messrs. James & Shakspeare
*h* „ „ „ „ Jackson & Till
*i* Quotations supplied by Messrs. Bolling & Lowe.
*j* „ „ „ „ Henry C. Yeo & Co.
*k* „ „ „ „ Morris Ashby, Limited.
*l* „ „ „ „ Sanders, Wake & Co.
*m* „ „ „ „ W. T. Glover & Co., Ltd.
*n* „ „ „ „ P. Ormiston & Sons.
*o* „ „ „ „ Johnson, Matthey & Co., Ltd

## INSTITUTION OF ELECTRICAL ENGINEERS.

"Improvements in Magnetic Space Telegraphy." By Dr. Oliver Lodge, F.R.S., Member. (Paper read December 8th, 1898).

(*Concluded from page* 105.)

In these early trials the tripod merely pressed against the mica disc of the transmitter; but the mica was now removed and a simple carbon plate substituted, against which the vertex of the tripod attached to the coil pressed; but this was no improvement. Hitherto the coil was pressed up, resting on elastic pellets below, and was under considerable restraint; now, finally, the tripod was attached rigidly to the centre of the carbon plate of the Berliner transmitter, and the coil was allowed to hang freely in the magnetic air gap. This was much the best plan; but for tuning, a spiral spring is still sometimes used to regulate the dominant pitch appropriate to the disc and coil as a vibrating system.

The method of connecting the magnifier to the telephone listened to was usually as follows:—

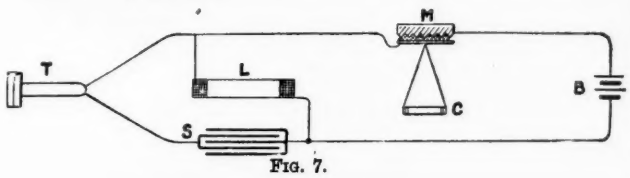


Fig. 7.

T is any telephone, diagrammatically indicated.

M is the Berliner microphonic transmitter, with receiving coil hanging on tripod from its carbon plate.

B is a battery of three storage cells, and L is a self-induction coil, without iron, which carries most of the steady current which is necessary to the good action of a microphone, but diverts the jerks and fluctuations mostly through the telephone, which might without detriment be of high resistance.

Sometimes a condenser, S, was inserted in its circuit, too, with the object of assisting through the telephone fluctuations of definite pitch.

A transformer could be used instead of the self-induction shunt, but the advantage of a transformer is more felt on long lines, for a compact apparatus it serves too, but it wastes more power than the L shunt.

The following arrangement was tried with the receiver at my house and the signals sent from the College, two miles away:—

A is the cable once round the garden, connected to the thick wind-

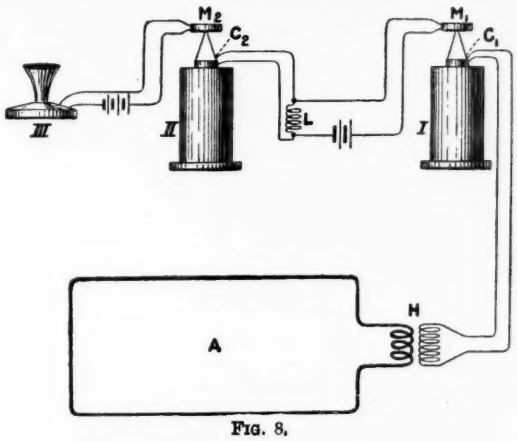


Fig. 8.

ing of a hedgehog transformer, H. Its thin winding is connected to the fine wire suspended coil of the first magnifying telephone, I.

The currents from its transmitter, $M_1$, are taken to the fine wire coil of the next magnifier, II, shunted by the low resistance self-induction coil, L.

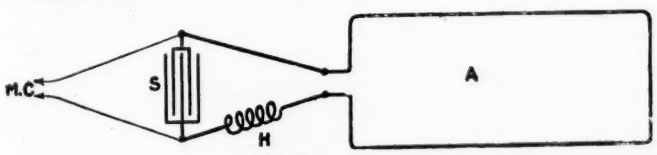


Fig. 9.

III is the final telephone of the series, viz., an ordinary Western Electric loud speaker (2 ohms), in series with the transmitter, $M_2$. Under these circumstances the signals could be heard with the ear 2 inches from the funnel of III.

But the hedgehog wasted a lot of power; its volume of iron being considerable, and the hysteresis and eddy losses at high frequency being very marked.

An improved arrangement consisted in interposing a 20-microfarad condenser (the largest then available). This was not enough to tune up the circuit, except where the thin wire circuit of the hedgehog was enclosed. So the following plan was adopted, and was a decided improvement:—

M C is the magnifying arrangement, as before.

H is the thick wire of the hedgehog, inserted merely as extra self-induction.

S is a condenser having a capacity of 20 or 21, or sometimes as much as 24 microfarads (a small plug condenser being added in parallel to vary and improve the tuning).

Thus the note was enhanced by resonance, and the signals became almost loud. (The tuning at the College end happened, however, on this particular occasion to be rather poor).

This must serve as a sample of a great number of experiments, made with all manner of condensers and different notes, an especial amount of variation being practised at the sending end.

It is to be remarked that fine wire coils to the telephones are by no means the best for this particular purpose, and afterwards ribbon coils of thin aluminium strip were used instead. Transformers and

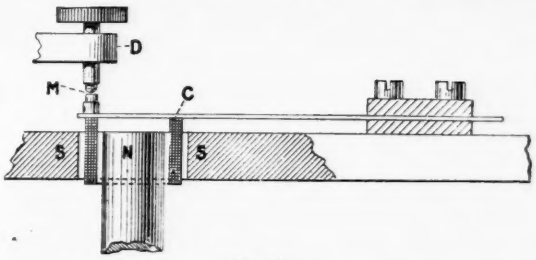


Fig. 10.

L shunts could then be dispensed with, but small telephonic transformers are still usually employed to prevent the constraint exerted on the hanging coil by a steady current passing through it. Small transformers don't waste much, and a little waste of power matters nothing where there is a local battery.

The Berliner or such-like granular transmitters, though serving well to magnify an already audible current, do not serve to pick up and magnify an inaudible one. For this purpose a better and more precise apparatus has to be constructed, viz, the reed or the tuning fork magnifying telephone with only a single pair of carbon contacts.

This is shown in fig. 10, and its essence is that the coil is hung to a reed or fork or vibrator of definite pitch, and carries also a pellet of carbon, which presses lightly upward on another fixed pellet, thereby constituting a single contact microphone.

Such an arrangement, as is well known, is excessively sensitive to utterly imperceptible mechanical disturbances, and the minutest fluctuations of current now passing through the hanging coil give ultra-microscopic tremors sufficient to vary the resistance of the light carbon contact perceptibly; the energy of a single cell local battery being thus brought into action, enough energy is imparted to disturb through another hanging coil one of the ordinary granular transmitters, which then passes on a stronger current to the loud speaker, or the "call." Or it may be that two reed magnifiers in series are desirable, when the received current is exceedingly faint.

The single point magnifiers do not carry big currents, and they require delicate, though easy, adjustment; but when properly made and adjusted, they work extremely well with pure tones.

The multiple contact microphones work better for articulate speech, as is well known. I find graphite carbon the best for these single

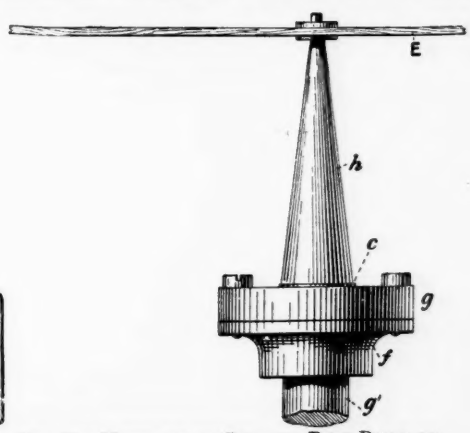


Fig. 11.—Mounting of Coil and Pole Piece of Sound Board Telephone.

contacts, and I am indebted to Mr. Swan, to Le Carbone, and to Mr. Acheson for several specimens of soft carbon, which answer much better than the harder arc lamp variety.

The last telephone of the series has been so far represented as one of ordinary pattern, but it is obvious that the vibrating coil attached to a wooden sound board may be employed; and, further, that such sound board telephone may have an application to the human voice and the acoustics of buildings.

It is also manifest that when the vibrations are magnified they may be used to work a relay and ring a bell, or actuate a Morse instrument, or anything else, just as in the phonoporic receiver, for instance. I am indebted to Mr. Langdon-Davies for the loan of one of his phonoporic receivers.

The bell-ringing arrangement that we at present prefer is a coil telephone of the tuning fork pattern, so that (if protected from mechanical shaking) it shall only respond to a definite note, and not to casual currents in the line.

The light coil hangs to the limb of a large tuning fork, and on this or on the other limb is a light metallic contact which dances when the limb vibrates, thereby practically breaking a local relay circuit and letting its tongue fly over, so as to close a bell circuit.

A diagram is hardly necessary, but here it is:—

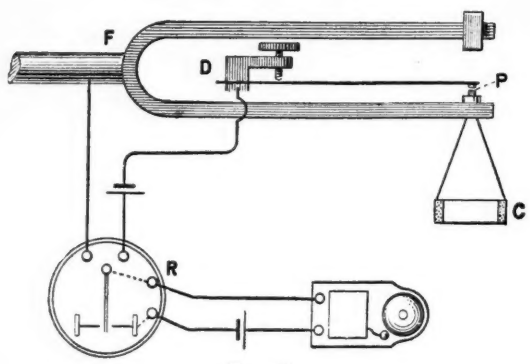


Fig. 12.

C is the last of the series of the suspended magnifying telephone coils.

F is a tuning fork on firm stand.

D is also rigidly supported, and carries a thumb screw for adjustment of spring.

P is a platinum stud contact carried by a very light spring, and this forms part of the local polarised relay circuit.

R, which rings a bell in the very ordinary way in any office where calling up is desired.

It may be thought that a light coil is hardly competent to shake appreciably the massive steel limbs of a tuning fork; but when it is isochronously attuned to the pulsations of the received disturbance, a tuning fork is wonderfully sensitive (even to aerial vibrations, as is well known in an ordinary resonance experiment); and the fact that it is not sensitive to disturbances of accidental frequency is wholly advantageous.

The light trembling spring is, however, readily disturbed by any sort of shaking, and if the relay is too delicately adjusted, it may give spurious calls due to mechanical tremors. From these it must be guarded.

Continuous working at the subject for over a year on the part of Mr. Benjamin Davies and myself, with occasional aid from instrument makers, has naturally resulted in a mass of observations and experiments. What is now published is but a fragmentary selection, but the paper is quite long enough.

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"Telegraphy by Magnetic Induction." By S. Evershed, Associate. (Read December 22nd, 1898)

Although many practical trials of telegraphy by means of the mutual induction between two distant circuits have been made during the past ten years, this form of wireless telegraphy has of late been rather overshadowed by the more brilliant possibilities of telegraphy by means of Hertzian waves of high frequency, and the low-frequency electro-magnetic system has hardly received the attention it deserves. It is probably not capable of such general application as Hertzian telegraphy, but it has a distinct advantage in employing electro-magnetic waves of low frequency, the laws of which are simple and well understood, and the necessary apparatus for transmitting and receiving will not be too remote in type from dynamos and motors to enable us to readily understand the principles on which their design and working should be based. Moreover, with one limitation, to which reference will afterwards be made, our knowledge of the laws of magnetic induction is sufficient to enable us to determine precisely what conditions are requisite for communication with a place at any distance.

The author's attention was directed to the subject some years ago in connection with communication between light-vessels and the shore, and his magnetic induction telegraph was, as is pretty generally known, tried between the North Sand Head light-vessel and Dumpton Gap, and proved a total failure, owing to the almost complete absorption of the electro-magnetic waves by the media through which they were required to pass.

During the time these trials were in preparation exhaustive experiments were carried out at Woodfield Works by the author, in conjunction with Mr. Oswald Cox, and the main principles of telegraphy by magnetic induction were investigated, and one or two fundamental formulæ worked out. It will not be inappropriate at the present time, when wireless telegraphy is coming into prominence, to put the conditions then arrived at before the members of the Institution as briefly as possible.

When we desire to convey energy through space from one place to another by electro-magnetic waves, we must provide a primary circuit at one place to emit the induction waves, and a secondary circuit at the other place to receive them. Every time a current is varied in any way in the primary a certain fraction of the energy linked with this circuit will appear in the secondary, to run down there into heat (as $C^2 R$), unless there is a motor or other translational device included in the secondary. By maintaining an alternate current in the primary a continuous supply of energy is available in the secondary, and a suitable indicator in the secondary —that is to say, a motor adapted to convert part of the received electrical energy into energy of motion, either visible or audible— will enable the receipt of the energy to be detected. Break up the primary current into dots and dashes, and you have a working telegraph.

Of course, there are other means of indication which are not in any ordinary sense motors. For example, electrolytic effects may give a direct indication of the secondary current, or a coherer may be used to give indirect indication by closing a local circuit. But the principles underlying the application of magnetic induction to wireless telegraphy will be better understood if we assume the indicating device to convert some part of the received energy into motion. It may be motion only capable of bringing two contacts together to close a local circuit, or capable of making audible sound waves in the air, or it may be directly visible; but in any case something is made to move; and the moving body being, presumably, attached to some support, either by pivots or an elastic suspension, cannot be moved without the expenditure of energy to overcome the mechanical friction of the pivots or the molecular friction of the suspension. If sound waves are set up there is a further expenditure of energy.

The secondary current being, of course, an alternating one, it is probable that the motion imparted to the indicating device will be oscillatory also. The ordinary Bell telephone will occur to everyone as typical of such an indicating device. The friction— resistance to motion—may follow any law with regard to velocity, it may even be constant (independent of velocity), but in every case examined by the author the frictional resistance has proved to be simply proportional to the velocity—at all events at such frequencies as are likely to be used in practice. In what follows it will be assumed that when moving with velocity, $v$, the moving body requires a force equal to $r\,v$ to overcome friction, $r$ being a constant for any particular moving system. Calling the amplitude of oscillation $a$, and if $p = 2\,\pi\,\text{F}$, the mean power required to oscillate the moving part will be $= \frac{1}{2}\,r\,a^2\,p^2$, and at its maximum value the power spent in overcoming friction will be $r\,a^2\,p^2$; the oscillation being a simple sine function.

Having got an indicator, the first step towards its application to an induction telegraph must be to determine the value of the coefficient $r$, and to decide upon a value for the amplitude $a$, which will give indications of the necessary magnitude. These two data will enable primary and secondary circuits to be designed to give the required secondary power with any given primary power.

### The Inductive Circuits.

There are two practicable ways of building such circuits. The first consists of running a pole line of sufficient length at each end of, and at right angles to, the imaginary line joining the two points between which communication is to be established. Each pole line being earthed at both ends, the circuits complete themselves through the earth, and form two circuits in parallel vertical planes. This is the system devised by Mr. W. H. Preece. It was in practical use long before any other system of wireless telegraphy was heard of, and, indeed, it is very largely due to Mr. Preece's early and continuous work in this connection that we have any wireless telegraphy to discuss to-day. The efficiency of this system, taking cost of materials as a measure of efficiency, depends on the average depth at which the current travels in returning through the earth from one earth pole to the other. Many experiments have been made by the Post Office authorities to determine the mean depth of the return path, but the author understands that the results do not indicate any definite law governing the relation between length of pole line and depth of return. In these circumstances it becomes impossible to accurately forecast what any proposed pair of lines will do. Moreover, leakage from one circuit to the other complicates matters.

The other method of forming the primary and secondary circuits consists in running a pole line completely round the boundary of a sufficient area of ground at each station. This, in effect, turns Mr. Preece's two vertical circuits into two horizontal circuits, and there is the immediate loss of one-half the mutual induction between them —an effect only compensated for if the area of the horizontal circuits can be increased. If the areas of the primary and secondary circuits are $A_p$ and $A_s$ respectively, and the distance between them is D (D being large compared with the diameters of the circuits), then the total induction threading the secondary,

$$\text{B} = \frac{2\,A_p\,A_s\,C}{D^3} \qquad (1)$$

when the circuits are in parallel planes normal to the line joining their centres; while in the case of the two circuits lying in the same plane

$$\text{B} = \frac{A_p\,A_s\,C}{D^3} \qquad (2)$$

Another point to bear in mind when comparing the vertical and

horizontal systems is that in the former a pole line is only used over half the whole length of circuit, the remainder being made up by the earth return. In the latter the pole line extends right round the circuit, and is on that account likely to prove more costly.

However, horizontal circuits possess compensating advantages which may easily outweigh their drawbacks, and in the following formulæ for determining the volume of copper in the lines, areas of circuits, and primary power required for signalling over any given distance, the circuits are supposed to be laid in a horizontal plane.

The expressions given in (1) and (2) show that circular circuits will give the maximum effect for a given length of pole line. But this is an ideal form which could hardly be contemplated in practice, and it will therefore be assumed that each circuit forms the boundary of a square area. Since each circuit will have to serve for both transmitting and receiving, it is clear that they must, if possible, be identical in size and shape.

Let

$V_p$, $N_p$, $R_p$ be the total volume of wire, number of turns, and resistance of the primary circuit.

$V_s$, $N_s$, $R_s$, the corresponding values for the secondary circuit.

$a$ sectional area of line wire.

$\rho$ specific resistance of line wire.

$s$ length of side of square circuit.

$D$ distance from centre of primary to centre of secondary.

$C_p$ value of primary current.

$W_p$ value of power spent in primary.

$W_s$ total electrical power in secondary.

$B$ total magnetic induction threading secondary.

$E_s$ impressed E.M.F. in secondary.

$C_s$ current in secondary.

$M$ mechanical power of indicator or motor in secondary.

All the cyclic quantities are assumed to be simple sine functions, and the letters denoting them stand for their maximum (crest of wave) values.

The whole of the power required in the primary circuit is assumed to be that wasted in heating the wires. To be strictly accurate, the power radiated into space, of which a minute fraction appears in the secondary, should be added; but at the low frequencies suitable for working the whole radiated power is very small compared with $C^2_p R_p$.

To get the greatest possible conversion into mechanical energy in the secondary, $E_s$ must be in step with $C_s$, and the condition for maximum activity of a motor must be fulfilled. As is well known, this condition requires the back E.M.F. of the motor to be equal to one-half the impressed E.M.F. The highest possible value for the mechanical power of the secondary indicator is, therefore,

$$M = \tfrac{1}{2} E_s C_s.$$

But $$C_s = \frac{E_s}{2 R_s}\text{; so that } M = \frac{E^2}{4 R_s}.$$

Now $$E_s = p B = \frac{p s^4 N_s N_p C_p}{D^3}\text{; and since } C_p = \sqrt{\frac{W_p}{R_p}},$$

$$R_p = \frac{4 \rho s N_p}{a}\text{, and } a = \frac{V_p}{4 s N_p}\text{, we have—}$$

$$E_s^2 = \frac{p^2 s^6 N_s^2 W_p V_p}{16 D^6 \rho} \qquad (3)$$

also $$\frac{R_s = 16 \rho s^2 N_s^2}{V_s};$$

so that, finally,

$$M = \frac{E_s^2}{4 R_s} = \frac{p^2 s^4 W_p V_p V_s}{16^2 D^6 \rho^2} \qquad (4)$$

Here we have an expression for the power turned into audible, visible, or in any other way discoverable motion by an indicator considered as a motor—a motor which is only required to overcome its own mechanical friction, and working under the ideal conditions of maximum activity, negligible electrical resistance and self-inductance, E.M.F. and current in step, and, lastly, *absence of any medium which can absorb* or distort the magnetic waves on their road between the two circuits.

As might have been anticipated, the mechanical power does not depend in any way on the number of turns of wire into which $V_p$ and $V_s$ may be divided. The number of turns in primary and secondary will depend only on the E.M.F. of primary generator, and E.M.F. for which the motor is designed; these are questions entirely distinct from the mechanical work to be done, just as the bearing friction in an ordinary motor is quite independent of the volts and amperes of the machine. Formula (4) also indicates that the least volume of wire will be used if we make $V_p = V_s$; and in that case, if we put $V_t$ for the total volume of wire used in the construction of the two circuits, (4) becomes

$$M = \frac{p^2 s^4 W_p V_t^2}{32^2 D^6 \rho^2} \qquad (4^a)$$

At this point it will be useful, by working out an example, to give an idea of the mechanical power which can be delivered at a distance of several miles by the expenditure of a reasonable amount of power in the primary circuit, and by means of a practicable weight of wire.

Suppose we put 1,000 kilogrammes (about 1 ton) of copper wire into circuits 1,000 metres square and 10 kilometres apart. Let the frequency be 100 ~, and the mean power spent in the primary circuit be 100 watts. That is to say,

$p = 628$, $s = 10^5$ cm., $W_p = 200 \times 10^7$ ergs per second,

$V_t = \frac{10^6}{8 \cdot 9} = 1{\cdot}1 \times 10^5$ c.c, $\rho = 1{\cdot}7 \times 10^3$ C.G.S. units, and

$D = 10^6$ cm.

If these values are put into ($4^a$) we get

$$M = 0{\cdot}34 \text{ ergs per second.}$$

Now, as will presently appear, it is quite easy to obtain indicating instruments which will work with less than one-third of an erg per second; but it must not be forgotten that the value just given for the mechanical power available is under ideal conditions that can only be approached—never reached.

*(To be continued.)*

## REFUSE DESTRUCTION AND ELECTRIC LIGHTING IN ST. PANCRAS.

### THE HEAT WORTH £50 A YEAR!

IN view of the increasing interest now being manifested in the use of refuse destructors in connection with electric lighting, it may be instructive to place on record some facts which have just been brought to light in the case of the St. Pancras installation. Some time ago this particular destructor was transferred from the Works Committee to a Special Dusting and Refuse Destructor Committee, and, as might be expected, the destructor *per se* has yielded more satisfactory results under separate control that when it was included among the many other duties of the former Committee.

In a report by the Special Committee, the consideration of which was postponed last week until the next meeting of the Vestry, it is pointed out that as compared with the corresponding period of 1897, the average weight per load collected by the Vestry in the east and west divisions has been increased from 1 ton 5 cwts. to 1 ton 7¾ cwts; that the average cost per ton in wages and horse hire for collecting has been reduced from 4s. 2⅝d. to 3s. 6½d.; that the average amount consumed per cell per day has been advanced from 5 tons 5 cwts. to 6 tons 6½ cwts; that the cost in total wages for destruction of refuse has been reduced from 2s. 4d. per ton to 1s. 10⅜d. per ton, and that the total quantity of refuse now received at the destructor is greater since the completion of the reconstruction of the cells than it was previous to that time. It may be mentioned that the work of reconstructing the 18 cells, which are now all worked with forced blast, has only recently been completed.

In a lengthy explanatory report by Mr. Joseph Thornley, J.P., chairman of the Special Committee, particular attention is drawn to this feature—that during the 12 months ended Michaelmas, 1898, the work of destruction has been hampered in consequence of the reconstruction of the cells, &c. He further says that "had it been possible to work under the same conditions as those existing at present, it would, I feel convinced, have been an easy matter to have consumed in 12 months at least 35,000 tons, or nearly 80 per cent. more than was actually destroyed. Moreover, if the destruction had been carried on for seven days a week, as was the case previously to your Committee taking this work in hand, it would be necessary to add one-sixth to the above-mentioned figures, and the ultimate result would then yield nearly a 100 per cent. increase." The quantity of refuse destroyed during the year in question amounted to 19,768 tons. The chairman of the Committee, at the close of his report, says that "a source of income which has been discarded up to the present lies in the enormous resources we possess for generating electricity by the mere destruction of this refuse. It is difficult even to estimate what this particular branch of revenue may produce; but as soon as the Electricity Committee provide the necessary apparatus for the due consumption of the gases which now needlessly escape up the shaft, as they have undertaken to do, it will then be possible to ascertain something definite in that direction."

Mr. J. Thornley, who opened the discussion last week on the several reports and tabular statements concerning the disposal of the parish refuse, expressed the opinion, in the course of a long speech, that it could be shown that the waste gases were worth £1,000 a year to the Electricity Committee for steam raising purposes. The boilers were already in the destructor yard, and it was the duty of the Electricity Committee to get them to work, but they appeared to remain out in the cold. If the value of the steam was only £300 or £400 per annum it was worth having. It was only last month that the furnaces were got fully to work, and the Electricity Committee should take the steam without delay.

Mr. Barnes expressed the hope that the Electricity Committee would seriously consider the question of utilising the heat from the destructor. The latter had been depicted a few years ago in glowing terms as a means towards lighting the parish by electricity.

Dr. Walter Smith, chairman of the Electricity Committee, said that the Committee had endeavoured to use the superfluous heat, and had incurred some expense for that purpose. It was found that a fair amount of heat went towards the electricity works, but that by the time it reached there a good deal of it had disappeared. Then, again, the dust so choked them up, that it cost more to clean the dust out of the boilers than the value of the heat was to the electricity department. The engineer had made some careful tests with the boilers there, showing that to be the case. It was incorrect that the Committee would be able to obtain an enormous amount of heat when the two boilers were erected. The value of the surplus heat would then amount to about £50 a year. That was something, but when it was considered that they were spending £2,000 a year on coal for the King's Road station, the sum of £50 was really a very small proportion of the total cost of fuel. The speaker did not think that the heat from the destructor was worth five minutes' consideration.

They all thought at one time that it would be possible to get a large amount of heat from the destructor, but it was found they could do nothing of the kind, and it was not likely that they would do anything of the sort. At the same time the Committee would only be too glad to assist in utilising the heat as much as possible. The boilers would have been put in before, but it was a question whether it was a wise policy to do so for the possible gain of £50 per annum.

Mr. Hodgson submitted figures which, in his opinion, showed that the total cost of collection and destruction of the refuse by the Vestry amounted to no less than 7s. 7d. per ton, or about 4s. per ton in excess of the refuse being removed and disposed of by a contractor.

Mr. Rutter said that if steam could be obtained from the destructor at all times, and in the quantity required, the value of the heat units that could be obtained barely amounted to £50 a year. The figures had been worked out by the chief electrical engineer. The most important point against the destructor was that steam could not be obtained at a constant pressure. It was necessary to have the steam at such a pressure, or otherwise there would be a flicker in the light. In most cases during the experiments there had been a drop in the pressure of the steam, and that was the reason why the destructor would never produce steam for an electric lighting undertaking of the magnitude of that of the Vestry. It would be all right for a small enterprise, but the electricity department always required more steam than the destructor could ever possibly raise. It was a myth to suppose that the electricity undertaking would ever get steam of any value for the electric lighting station.

Mr. Thornley, in the course of his reply to the discussion, stated that they had sufficient power from four to six cells to drive a 25-H.P. stone breaker. As to the utility of the heat from the destructor, he would undertake to introduce to the Electricity Committee an electrician who would show them how to do it, and how to save several hundreds of pounds a year to the electricity department when the heat was used. Of course if the committee looked at but would not utilise the gases, he could not help it. The discussion then terminated.

## PHYSICS AND ELECTRICAL ENGINEERING IN 1898.

WE reproduce the following notes on physics and electrical engineering in 1898 from the *Times* review of the science progress of the year:—

"Two years ago Dr. P. Zeeman made the interesting discovery that, if a flame coloured with sodium salts was placed between the poles of a powerful electro-magnet, when the magnet was excited the spectrum of the light underwent a remarkable change. Viewed in a direction along the lines of force, both of the spectral lines were seen to be doubled, and their light circularly polarised. If examined in a direction across the lines of the field, each single yellow sodium line was seen to be split into three lines, the light coming from all the members of the triplet being plane polarised. The detection of these changes, under the most favourable circumstances very minute, was only rendered possible by the employment of the best optical apparatus. During the year just closed, the Zeeman phenomenon has been more completely examined. Mr. Tolver Preston and Dr. Zeeman have photographed the bright line spectra of various metals, such as cadmium and zinc, with the spark points placed in a strong magnetic field. The effect is only found to occur when the origin of the light is placed in the magnetic field. MM. A. Cornu and A. A. Michelson have also brought their great optical experience to bear on this subject, and have fully confirmed the discovery of Zeeman. The interest attaching to the matter is, that it makes known yet another relation between magnetism and light, and is probably not unconnected with the effect discovered long ago by Faraday, viz., the rotation of the plane of polarisation of light when passing through certain transparent bodies placed in a magnetic field. The theory of the phenomenon has recently been expounded by Prof. H. A. Lorentz, Dr. J. Larmor, and Prof. G. F. Fitzgerald. Modern electrical research tends to show that atoms of matter or some smaller constituent corpuscles carry on them electrical charges, and these electrical charges are probably capable of vibration, independently of the mass movements of the atom itself. Roughly speaking, we may think of the electrical charge of an atom as carried about by the atom like a passenger in a carriage, but yet as capable of independent displacement in its conveyance. There are reasons for thinking that it is only by a sudden or very rapid disturbance or movement of an electric charge that we can start into existence the wave motion in the universal ether which constitutes radiation, and, when of a particular wave length, light. Hence, in order that a body may be luminous, it is necessary that the atomic electrical charges should be brought into a state of rapid vibration. In a profoundly analytical examination of fundamental phenomena, Dr. J. Larmor has, in a series of recent memoirs, presented to the Royal Society, elaborated an electrical theory of matter. Starting from the assumption of a space-filling ether possessing the attributes of inertia and elasticity, he constructs a theory of matter in which what we call atoms are supposed to be formed of collocations of electrons. Electrons may be either positive or negative, and are the ultimate indivisible units of electrical charge or quantity. An atom is assumed to be a microcosm formed of electrons in stable orbital motion round each other, and the atomic charge will depend on the total composition of the atom as regards electrons. An electron itself is a strain-centre or point of convergence of a certain ether structure, and isolated, or in company with other electrons, can move from place to place in a stationary ether just as a kink on a rope is a strain-form which can move along a stationary rope. When these electrons vibrate they communicate wave motion to the ether, and as they consist, so to speak, of elementary charges of electricity in motion they create and are affected by a magnetic field.

"If a radiant body is placed in a magnetic field the orbital motions of these electrons or atomic charges are affected. Vibrations along the lines of magnetic force are unaltered, but vibrations in other directions are quickened or retarded according to the direction of rotation of the electron. If then such a body is viewed with the spectroscope and if the atomic motions are of such a character as to produce a spectrum of bright lines, it follows that the spectrum must be affected by the magnetic field. For each bright line in the spectrum corresponds to, and is the optical expression of, a set of atomic variations or oscillations of electrons having a certain period. If some of these vibrations are slightly quickened and others slightly retarded this change will make itself evident by the widening of the spectral line or by the appearance of other bright lines on either side of it. The Zeeman effect can therefore be interpreted in terms of that theory which regards radiation as due to the oscillations of electrical atomic charges or to electrons, and its further exploration promises to put to the test some far-reaching hypotheses as to the structure of matter as well as that generally-accepted one which seeks for the origin of all electric and magnetic phenomena in affections of the ubiquitous ether.

"Closely connected with the above subject is the progress that has been made in the art of manufacture of ether waves. Before the time of Hertz's brilliant discoveries, the only vibrations in the ether with which we were acquainted were those produced by the natural oscillations of atomic electrical charges, and made evident as ultra-red, visible, or ultra-violet radiation. Hertz showed us how to manufacture, electrically, other ether waves of wave length a million times greater than those which give rise to visible light, and since his time numerous investigators have sought to produce Hertz waves of continually smaller wave length. In Italy, Lampa has succeeded in generating Hertz waves of about 4 millimetres in wave length. Other investigators, attacking the problem from the other side, have endeavoured to sift out from ordinary dark heat radiation the shorter wave lengths, and leave the longer ones. This last year Drs. H. Rubens and E. Aschkinass have achieved the feat of filtering out from an heterogeneous radiation the waves of very great wave length existing in the radiation of an Auer burner. This they accomplished by repeated reflections from rock salt or sylvine. They have thus obtained invisible radiation or ether waves, having a wave length 100 times greater than those which give rise to the sensation of red light, but at the same time of only $\frac{1}{100}$th part of the wave length of the shortest known Hertz waves. There remain about five octaves of as yet unknown radiation to be produced, but when this is done we shall know how to create the whole of the vast gamut of ether waves lying between the ultra-violet light, found by Schumann to have a wave length of $\frac{1}{10000}$th of a millimetre, and Hertz waves of many metres in length. The subject of ether waves leads naturally to that of the so-called wireless telegraphy to which much attention has been given during 1898. There are several methods by which electric or magnetic effects can be utilised for telegraphy without the use of a continuous wire between the two stations. One of the most simple is that which at one time engaged the attention of Mr. Willoughby Smith and Mr. Stevenson, and more lately of Mr. W. H. Preece and Dr. Lodge. In the form in which it has been put into practice by Mr. Preece and the officials of the Postal Telegraph Department it consists in making an interrupted or alternating current in one line or circuit. At some distant place there is a receiving line or secondary circuit in which a secondary electric current is generated by magnetic induction across space. The secondary current is detected by a suitable sensitive receiving instrument, and can be made to give rise to appropriate signals. This method has been put into practical operation by the Post Office between Lavernock and Flat Holm, on the Bristol Channel, over a distance of three or four miles, and is now in daily use for sending messages. The other method, which has attracted more popular attention, is based on the employment of Hertz waves, and has been especially developed by Signor G. Marconi. In this wave system a long insulated upright rod or wire is erected at each of the terminal stations. At the sending station an induction coil with spark balls is connected between the bottom of the rod and the earth, and at the receiving station a very sensitive detector, consisting of a Branly tube or tube containing fine metallic filings, is inserted between the upright rod and the earth. When the induction coil is in action rapid electrical oscillations are made in the transmitting rod and ether waves sent out from it. These, on reaching the receiving rod, set up an electromotive force in it which causes the metallic filings in the detector tube in connection with the rod to become conductive. By means of a relay and battery this electrical change in the detector can be made to print Morse signals on a strip of paper utilising an ordinary Morse instrument.

"An important scientific event of the year having especial reference to physics is the issue of the report of the committee appointed by the Treasury to consider the question of establishing a National Physical Laboratory. It has long been felt that Great Britain should have some laboratory which should undertake special quantitative researches in the interest of science and technology analogous to those so well carried out by the Physikalisch-Technische-Reichsanstalt in Berlin. Evidence was given before the Treasury Committee of the importance of this work, and the Committee have recommended an enlargement and extension of Kew Observatory for this purpose, and that the control of the new institution should be vested in the Royal Society.

"Turning next to the progress of electrical technology in 1898, we find an enormous increase in the amount of capital invested in electrical enterprises, private and municipal. According to 'Garcke's Manual of Electrical Undertakings,' there were at the beginning of

1898 in Great Britain 412 undertakings having a total capital investment of £84,742,020. These are classified into telegraph, telephone, electric lighting, electric traction, and electrical manufacturing enterprises. The great feature of the past year is the extent to which the local authorities are availing themselves of legal powers to become electrical suppliers for light or traction. In 1898 the amount of loans authorised to municipalities for this purpose amounted to over 6 millions sterling. The total number of incandescent lamps in use in the United Kingdom in connection with public electric supply now amounts to over 5 millions, of which nearly 2½ millions are supplied with current from municipal stations. There are now 130 towns in which there is a public electric supply station, and the total sale of electric energy during the year 1897 amounted to about 100 million Board of Trade units, an output which will, no doubt, be found to be largely exceeded in 1899.

"In March, 1898, a joint committee of both Houses of Parliament was appointed to report on certain important questions which had arisen in connection with the law of electric lighting, and particularly on the compulsory purchase of sites for electric supply stations and also on the right to make electric supply in bulk to many towns from a common centre. This last matter arose out of a very extensive project for the supply of electric energy over an area of about 2,000 square miles in the Midlands. The committee reported in favour of powers being granted for such bulk supply in cases where sufficient advantage to the public can be shown.

"In view of the projection of large schemes for the supply of electric energy in bulk over large areas both in the Midlands and in Lancashire, it must be noted that a very important question is closely connected with it. It is now clearly recognised that the output in Board of Trade units of an electric station is a prime factor in the cost of manufacture. In large towns, such as Edinburgh, where the electric supply station sends out one to two million units per annum, it is found that the cost of generation is less than 1d. per unit. An engineering problem which is arising for solution is the question whether an electrical distribution of energy on a still larger scale from sites near a coal-pit mouth will not be able to deliver power to manufacturing users within a certain radius at a rate comparable with that at which power is obtained in other countries from great natural falls of water. These large scale projects have, however, raised a note of opposition from the municipalities in the proposed areas of supply who are themselves possessed of municipal electric stations. The conflicting interests at stake are likely, therefore, to come into collision.

"The difficulties of supply at a pressure of 5,000 to 10,000 volts have been entirely overcome, and by means of two or three-phase alternating currents, power can now be transmitted electrically at a high pressure, and reduced to low pressure continuous currents for use with lamps, motors, or electro-chemical purposes. In electric traction there is some small but steady progress to report. In the beginning of 1898 there were about 120 miles of electric tramline or railway in the United Kingdom. Many of the local authorities are in the act of converting, or contemplate converting, their horse-car lines into overhead electric lines. The electrical tramways put into operation in 1898 comprise those in Glasgow, Liverpool, Bradford, Halifax, Kidderminster-Stourport, Middlesbrough-Stockton, Cork, and Laxey-Ramsey. An interesting report has been presented during the past year to the London County Council on the subject of mechanical traction for working the car lines under the control of the Council. A preference is expressed in the report for the conduit system of electric traction in dealing with the problem in London. In provincial towns the overhead system will, no doubt, be preferred; but there is a third system, called the surface knob system, which may ultimately turn out to have special advantages in urban traction. Electro-chemistry is making great strides. The electro-chemical purification of copper, the preparation of alkali and bleach from common salt, and the manufacture of calcium carbide for making of acetylene have all advanced to the position of great industries. Yet, great as are the modern utilisations of electrical energy for the purposes of illumination and power transmission, there are probably electro-chemical applications in the immediate future which will be greater still."

## THE USE OF GAS ENGINES FOR DYNAMO DRIVING.

It has often been remarked that the high cost of illuminating gas in America and the comparative cheapness of fuel has had very much to do with the rapid progress of electric lighting. Given gas at 7s. per 1,000 feet, electrical companies would have no occasion to hunt for customers, nor to use the argument of the blackened ceiling and ruined books, pictures, and hangings, in order to push business. Similarly the dearness of gas in America has been responsible for the slow progress of gas engines.

In England the infantile stage of the gas engine has been greatly assisted by the supply of excellent power gas, for bad as gas is as an illuminant the so-called illuminating gas sold in England is very good for gas engines, and is cheaper to use for small motive powers than is steam. Now that the gas engine has become a large powered machine, and has justified the putting down of special gas producing plant, it is attracting attention in America.

In Boston, United States, the Brookline Gas Company have agreed to reduce the price of gas for fuel purposes to about 3s. 2d. per 1,000 (75 cents), and to make sliding scale prices for power purposes, so that for engines of 100 H.P. about 1½ cents will provide 1 H.P.-hour, and in engines up to 200 H.P. the cost will be only 1$\frac{1}{10}$ cents. At this cost gas engines will be on a par with engines using 5 or 6 lbs. of coal per H.P.-hour. The Brookline Company will commence the new system as soon as the Massachusetts Pipe Line Company have completed their large coal gas plant at Everett, whence they intend to supply gas of 18 C.P.

In gas producers, so far, progress has been slow in America; but a writer in the *Electrical World*, from whose article the above is abstracted, looks forward to their considerable use as soon as Americans realise that the gas engine, fed by producers, will deliver more power per fuel unit than can be obtained from a steam engine.

As regards small engines their sale is being reduced by the competition of the electric motor. This is only to be expected. For small powers the gas engine is not to be compared, or should not be, with electricity. The proper place of the gas engine is before the electric motor, its duty to produce electricity from fuel. A 3-H.P. electric motor can be purchased for one half the cost of a 3-H.P. gas engine. It will weigh 450 lbs.; the gas engine will weigh 1,500 lbs. The electric motor will spend the whole cost of the gas engine the first year of work, or, say, £40 to £50. These are Mr. Kelley's figures. The present writer knows where the comparison might be safely extended very much in favour of the motor, however.

At the house of the American Society of Civil Engineers there is a direct connected 500-lights plant which has been a year at work and has given satisfaction. The gas engine is of Nash type, giving two impulses every two revolutions, and it regulates to 2 per cent. between full and no load, while the voltmeter only varies one volt. The heating is done by a low pressure steam heating apparatus, and experience has justified the combined system in place of a high pressure of steam for the lighting plant, and the use of exhaust for warming. The cost of fuel and attendance, said to be less than half that of street current, is not stated, whether gas from the street mains or producer gas made on the premises—the latter probably.

Even at their best, gas engines throw away half the heat of the gas which enters the cylinder, while the producer itself does not utilise more than 80 per cent. Something like 60 per cent. of the fuel heat must therefore disappear in the form of heat, and it seems proper to inquire if a warming system could not be devised to use such waste heat in place of a special steam warming apparatus being required.

As regards the greater cost of operating electric motors, it must not be forgotten that the gas engine with producer costs more for attendance, and also that for intermittent work the electric motor is at a standstill while the gas engine must run and must drive probably shafting. In fact, the same arguments which go to place the small gas power above the small steam power may be applied to the electric motor.

We know a London workshop where a length of 114 feet of shafting is driven by a gas engine, often the only work being a small fan of ¼-H.P. or less. Our readers can doubtless supply for themselves similar instances. In most small workshops the calculation of saving must not be made on the basis of power used but on power not used. It is in what is not driven that the economy of electricity will be largely found. And in the growth of electric driving the gas engine is bound to find a parallel expansion, but it will be in larger sizes than hitherto have been common. Gas engines of 250 H.P. are daily becoming more usual. We hear of one of this size just about to be started, if not already at work. This, however, is using gas from blast furnaces.

## DAMAGES FOR ELECTRIC SHOCK ON BRISBANE TRAMS.

The Brisbane papers for November 15th to 22nd contain a lengthy report of an interesting action heard there against the Brisbane Tramways Company, Limited. The claim was for £1,000 for injuries said to have been occasioned to Miss Margaret McLean, a milliner, by receiving an electric shock while entering a tramcar. Plaintiff's evidence was to the effect that when she stepped on to the footboard of the car she received an electric current of such severity, that it threw her to the ground. She was laid up for five or six weeks suffering from violent pains in her body, limbs, and head, a swelling in her throat, and paralysis of her left side. Her claim set out the theory that the contact between the rails and the cars was incomplete, and she received the current which should have passed through the rails. The defence was a general denial of all the allegations. It seems that as the tram stopped and plaintiff entered it, the lights were extinguished. She remembered subsequently hearing the conductor say that it was a new car, and the wheels were too large for the rails. Later, she heard him say that there was dirt on the rails. The medical evidence attributed plaintiff's condition to some nervous shock, and said that an electric shock would have been likely to cause it. She had suffered from rheumatism, and was not strong at the time of the accident. She was therefore more likely to suffer from shock than a healthy person. Mr. John Hesketh, Government electrical engineer, in giving evidence, described the tramway system. He said that if the contact between the car and the rails was broken one effect would be to stop the car. If a break occurred there would be immediately a current due to a pressure of 500 volts, or whatever pressure the trams might be worked at between the car and the rails. The car, in fact, would be charged with 500 volts. Provided persons were not connected with the car and the earth there would be no danger, but if a person were connected with the earth and the car he would be in the direct path of a current due to a pressure of 500 volts. That was a matter of common knowledge. Precautions could be made against that state of things. The precautions usually taken were to maintain a good contact between the wheels and the rails, and for that many devices had been introduced. On one tramway with which he was

formerly connected they tried a brush carried in front of the leading wheels of each car to keep the rails clean. That answered very well, but it was discarded because they were working at a pressure of only 200 volts, and they found that the cost of renewing the brushes was greater than the compensation they had to pay for shocks. Lord Kelvin in one case recommended the use of electric brushes to keep the contact between the rails and the cars complete. If the wheels were too large for the rails, or were resting on dirt, there would be an imperfect contact between the wheels and the rails, and it would be possible for any person to receive a shock The state of the wheels and rails had everything to do with the likelihood or the possibility of a shock. Dirty wheels, dirty rails, or imperfect contact were the causes of sparking, and when sparking occurred it was possible to get a shock. He had seen a car which was reported to be the car on which the accident happened It was one of the new cars. He had seen the rails on all the tracks of the company, and some of them were certainly not calculated to make a good contact between the wheels and the rails. The effect of new wheels on old rails would be to produce an imperfect contact, and therefore be favourable for sparking or shocks.

The company placed the car and the power at Mr. Hesketh's disposal to make tests. The system was one of 500 volts. Considerable evidence, medical and technical, was given. Mr. James Trackson, electrical engineer, Mr. O. W. Brain, assistant electrical engineer, to the New South Wales Railway Commissioners, gave evidence at length. Mr. J. S. Badger, manager and chief engineer of the tramways company, in the course of his evidence, said a great many things as to shocks, what would and what would not kill a man, and so on. Counsel having addressed the jury, the judge summed up, and after considering their verdict for nearly two hours, the jury found that the company was responsible for plaintiff receiving an electric shock, her injuries resulting therefrom; also, that the company did not take reasonable care to use the best precautions in known practice for securing the safety of the plaintiff. They awarded her £150 damages.

## ECONOMY TEST OF A FEED PUMP.

We drew attention recently to the large steam consumption reported for the auxiliary engines and pumps of some of the ships of the U.S. navy. The makers of the Weir feed pump have since written us (see their letter in our issue of January 20th) denying that their feed pump is a wasteful one, and we see in the *Mariner* that there have been made some tests of a novel type of steam pump of compound variety. The auxiliaries of the *Minneapolis* are said to be fairly economical, the H.P. of the main feed pumps being about half of 1 per cent. of the power of the main engines. Thus feed pumps are considerable power users, and it is essential they should be economical. The ordinary duplex feed pump used in the U.S. navy uses about 120 lbs. of steam per H.P.-hour. In the *Minneapolis* it was about 93 lbs. at best and 200 lbs. at the worst, while the *Blake* double acting pump only used 52 lbs., and this for a small unit.

The tests described were made at Messrs. Willans & Robinson's. The H.P. cylinder was 6 inches diameter, and the water cylinder 3½ inches, the L.P. steam cylinder being 9 inches, and the water cylinder again 3½ inches, all had the same stroke of 8 inches. The pump outlet was throttled to about 200 lbs. pressure to represent actual practice. Either side can be run as a separate pump, if necessary. There are no short strokes made, as in ordinary duplex pumps, as the valves are not operated by the other side. The pumps were worked condensing, without vacuum. When run compound the steam used was 52 lbs. per I.H.P.-hour, and when run simple it was 93·41 lbs.

The initial steam pressure was 112·5 lbs., which gave a mean in the H.P. cylinder of 58·06 and 30·28 in the L.P., the power developed being 2·54 and 3·07 I.H.P. respectively, or 5·61 total.

In the simple test, with 67·5 lbs. initial pressure, the mean pressure was 62·23; the I.H.P., 3·961; and the steam per I.H.P.-hour, 93.41.

Apparently, the compound pump saved about 70 lbs. of steam per I.H.P.-hour, as compared with ordinary pumps. Referred to the power, 5·61, this shows a total hourly saving of 393 lbs, or, say, 50 lbs. of coal. This is 1,200 lbs. per day of 24 hours. On such a steamer as the *Oceanic*, with 30,000 H.P., the trip of 5½ days would show 77 tons of coal saved. These are serious figures, and it seems just a trifle strange to find such savings effected by pumps using only 52 lbs. of steam per H.P.-hour.

On a ship, where the electric light engines ought to be of economical type, there should be no difficulty in saving very much more than this by means of electrical driving.

Let us suppose electric engines producing 1 horse-power for 16 lbs. of steam per hour, and assume 90 per cent engine efficiency, 90 per cent. dynamo efficiency, and 80 per cent. motor efficiency, the pump efficiency remaining as before. Then the 16 lbs. will become about 25 lbs., so that electrical driving might save half the coal now used by this best type of steam pump. As a practical fact, no ordinary slow moving piston engine can be economical without some means of keeping the cylinder hot, which could not conveniently be applied to a feed pump, and slow running auxiliary engines of any type must of necessity be exceedingly uneconomical. They appear so very small and trivial, that their enormous steam consumption is not looked into as it would be if better known. It is clear that if 52 lbs. be a comparative economy, there is ample room for the introduction of something better still. So far as electricity has yet been tried in parallel instances, it has given a good account of itself. It is in such work that electricity is well fitted—shall we say to shine.

## THE PROVISION FOR TEACHING ELECTRO-CHEMISTRY IN THIS COUNTRY AND ABROAD.

Considering the important position which electricity has now taken in the chemical and metallurgical industries, for proof of which we may refer our readers to the recent summary by Mr. Kershaw of progress in 1898,* we are surprised that our science colleges and technical institutes do not pay more attention to electro-chemistry and electro-metallurgy. So far as we are in possession of information, no college or institute in this country has yet commenced *regular courses* of lectures upon these subjects, and the provision made for dealing with them has been confined to short special courses. Two years ago Prof. Thompson gave such a special course of lectures at the Finsbury Technical College, and a similar course had been arranged by Profs. Ramsay and Fleming at University College for February and March of this year, but has been dropped owing to insufficient students having registered their names. At the South Kensington Central College practical work in electro-chemistry is arranged for under Prof. Armstrong, but we are not aware that any regular courses of lectures are provided even here. The provinces are no better provided for than London.

When we turn to Germany we find a totally different state of affairs. The following list has been compiled from the issue of the *Elektrotechnische Zeitschrift* for October 13th, 1898, and shows the provision made for electro-chemistry at certain of the German polytechnics and universities:—

*Aachen.*—(1) Profs. Classen and Verwer.
Practical Electro-chemistry.

(2) Prof. Borchers.

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|---|---|
| Electro-metallurgy ... ... ... ... | 2 hours weekly. |
| Introduction to design and erection of Metallurgical and Electro-metallurgical Apparatus and Factories ... ... ... ... | 3 hours weekly. |
| Introduction to independent work in Metallurgy and Electro-metallurgy ... ... | 6 hours weekly. |

*Berlin.*—Prof. von Knorre.

| | |
|---|---|
| General Electro-chemistry and Applications of Electrolytic Methods in Industry ... | 4 hours weekly. |
| Practical Electro-chemistry ... ... ... | 2 hours weekly. |

*Braunschweig.*—Profs. Meyer and Müller.

| | |
|---|---|
| Practical Electro-chemistry ... ... ... | 6 hours weekly. |

*Darmstadt.*—Profs. Diffenbach and Paul.

| | |
|---|---|
| General Electro-chemistry ... ... ... | 2 hours weekly. |
| Practical Electro-chemistry ... ... ... | Daily. |

*Dresden.*—Prof. Foerster.

| | |
|---|---|
| General Electro-chemistry ... ... ... | 2 hours weekly. |

*Hanover.*—(1) Prof. Ost.

| | |
|---|---|
| Electrolytic Analysis ... ... ... ... | 6 hours weekly. |

(2) Prof. Heim.

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|---|---|
| Practical Electro-chemistry ... ... ... | 4 hours weekly. |

*München.*—Dr. Hofer.

| | |
|---|---|
| General Electro-chemistry ... ... ... | 3 hours weekly. |
| Electrolytic Analysis ... ... ... ... | 1 hour weekly. |

It must be noted that these are regular courses of study, and not spasmodic attempts to deal with the subject, similar to those customary hitherto in this country. In view of these facts, it is not very surprising to learn that the electro-chemical industries are developing more rapidly abroad than in the United Kingdom. The following facts from a recent article in the *Times*, reviewing the chemical trade in 1898, are proof of the extent to which this development is effecting the British alkali industry.

Both on the Tyne and in South Lancashire the chemical trade is declining, owing to competition from the electrolytic chemical manufacturers, and to the progress of the industry in countries which we formerly supplied. American competition is now felt even in Australia. Bleach has dropped in value from £5 10s. to £4 12s. 6d. per ton; 70 per cent. caustic soda from £7 10s. to £7. On the Tyne, one works has been dismantled during the year, and only four now remain in operation.† "It seems probable that considerable increase in commercial enterprise and mental alertness is needed on the part of some of our firms."‡

No doubt the greater development of these industries abroad is partly due to the idea that water-power is necessary to render electrolytic methods of manufacture an economic success. It is, however, by no means yet certain that cheap fuel, and proximity to centres of trade, may not balance the advantages offered by water-power, and two electrolytic alkali works are already in operation in such a district in this country. Scientific and technical knowledge, and commercial enterprise, are, we fear, the chief things lacking at the present moment. The information we have given above relative to the provision of lectures and laboratory courses for this subject at German universities and polytechnics shows how far our rivals are ahead of us with respect to the former.

* Electrical Review, January 13th and 20th, 1899.
† The *Times*, January 6th, 1899.
‡ The *Times*, January 7th, 1899.

## THE LATE PROF. BARTHOLOMEW PRICE.

On December 29th last died a mathematician who made a very considerable mark on the scientific education of one generation, and afterwards attained so distinguished a position as a man of business and public affairs, that the value of his earlier scientific work might easily be overlooked. From 1842, till 1867, nearly every mathematical student at Oxford was a pupil of Prof. Bartholomew Price, and a very large number worked under his direct private tuition. The long unbroken series of senior mathematical scholars, who had been his private pupils, is only equalled by that of the Senior Wranglers taught by Routh, at Cambridge, and his pupil list includes the names of many who have since attained distinguished positions in the world. In it occur those of Lords Justices Cotton and Davey, the Bishops of Southwell and Hereford, William Spottiswoode, Henry J. Smith, perhaps the acutest intellect of them all, and such interesting names as Edward Stanhope and Charles Dodgson, the Lewis Carroll of the fairy stories and mental problems. The testimony of such men to the eminent ability and intellect of their tutor is conclusive, no less than their regard and respect for his personal character. The four volumes of Prof. Price's work on "The Infinitesimal Calculus" and its application to mechanics, exhibit the working of a mind conscientious, orderly, logical, and philosophical to a high degree, and these qualities, rather than originality, were the notes of all his work. The general design of his book, as well as the character of the working library formed while he was producing it, shows it to be inspired rather by the French mathematicians of the earlier part of the century, Fourier, Laplace, and Lagrange, than by any English writers. The author's knowledge of French and German mathematicians was very considerable, especially so if the narrow range of mathematical reading general at that time is considered.

To the end of his life he retained a great liking for the French writers on physics and mathematics, and bought their books in considerable numbers. It is generally agreed that the structure of the French language lends itself to clear and easy exposition, as do neither English nor German, and its peculiar quality of lucidity attracted Prof. Price's scholarly mind. The necessity of studying mathematics with the view to competitive examinations calls for, and has produced, books of an entirely different class; but the "Infinitesimal Calculus" is read and admired for the sake of its profound grasp of principle and philosophical character, and within the last few years a new edition has been demanded, principally for America.

The main facts of Prof. Price's life have been given by several journals, and need not be repeated, but a little may be added. His father was a country clergyman of admitted character and ability at Coln St. Dennis, in Gloucestershire, and possessed marked capacity for teaching. Coln St. Dennis is near the country town of Northleach, whose grammar school has a claim to a close scholarship at Pembroke College, Oxford, when it can produce a boy competent to take it. Price, educated at home by his father, qualified himself, technically, for the Pembroke scholarship by reading a Greek play by himself in the schoolroom at Northleach, and proceeded to Oxford. He devoted himself to mathematics, and entered only for a pass in classics; but in this examination he did so well, that the examiners placed his name in the honours list. This case of a valuable boy attracted to a college by a close scholarship attached to a country school is by no means singular, and some of the most distinguished members of Pembroke have begun their connection with it in this way.

Indeed, more important foundations than Pembroke have found that their interest is better served by taking the best boys every year from a school attached to them, even when they appear below their standard, than by competing for the cleverest boys in the open market. Loyalty of the dependents to the college can only be secured by loyalty of the college to its dependents. Mr. Price's academical course to the positions of fellow, tutor, bursar, professor, and finally, though near to the end of his life, Master of his College and Canon of Gloucester, was unbroken; but, at the same time, he did an immense amount of work, largely financial, for the University itself. While guiding with consummate acuteness and fidelity the financial affairs of the University, his mind was intently directed to the development of the science schools. Holding that a university is essentially Catholic, that no exact knowledge is alien to it, scientific studies promised to him the greatest hope for the future, and no one man has given greater support and encouragement to all efforts to establish science schools, medical, physical, biological or chemical, than the late Master of Pembroke. All scientific men in Oxford looked to him as a certain and powerful ally in their plans and hopes. Oxford is peculiar in that nearly the whole of its work is done by committees, and Prof. Price's great influence on these was due as much to his singular courtesy, tact, and consideration, as to his more conspicuous qualities of a clear head and capacity for business detail. The record of the latter part of his life from 1867 to 1898 is in the liberal spirit of Oxford and the prosperity of the University Press. His progressive sympathies, backed by a powerful intellect and an unequalled knowledge of the detail of University affairs, were so clearly shown on the Duke of Cleveland's Commission of 1872, that a determined effort of the Liberal opposition, led by Mr. Goschen, to add his name to the Salisbury Commission of 1877 only failed by 11 votes. The story of his conduct of the business of the University Press is written in the pages of the "Revised Version of the Bible," of the "New English Dictionary," and of Prof. Max Müller's edition of the "Sacred Books of the East." His canonical orders were the sign of a spirit and a principle that through his whole life controlled the forces of his intellect and his energy, and of a confident faith that never despaired, and was never downcast.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1899.

*Compiled expressly for this journal by* **W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham,** *to whom all inquiries should be addressed.*

462. "Improvements in arc lamps and lanterns." E. J. Shaw. Dated January 9th.

465. "Improvements in electric ceiling roses, fuse, and junction boxes, and wall sockets." J. Whitcher. Dated January 9th.

485. "Improvements in telegraphic relays." R. W. Paul. Dated January 9th.

490. "Improvements in electrical relays and transmitters." H. W. Sullivan. Dated January 9th.

503. "Improved advertisement frames adapted for the rooms of travellers' hotels, and provided with an electrically actuated clock with an alarm if desired." E. Belzon and P. Royer. Dated January 9th. (*Complete.*)

514. "Improvements in electric arc lamps." The Davy Electrical Construction Company, Limited, and J. L. E. Daniel. Dated January 9th.

516. "Improvements in telegraphic receiving and translating instruments." A. Muirhead. Dated January 9th.

517. "Improvements in type-printing telegraph apparatus." C. D. Abel. (Siemens & Halske, Aktiengesellschaft, Germany.) Dated January 9th.

537. "Improvements in pressure regulating apparatus for electric mains used chiefly in connection with storage batteries." J. S. Highfield. Dated January 10th.

540. "Improvements in methods of operating electro-motors and controllers, and switches connected therewith." P. V. McMahon. Dated January 10th.

571. "Improved electric arc lamp clutch and feed mechanism." H. V. James. Dated January 10th.

580. "Telephone system." D. H. Wilson. Dated January 10th (*Complete.*)

582. "A method of operating electric tramcars, &c., where a combined or alternate fixed line conductor and accumulator traction is used." J. Dugdill. Dated January 10th.

626. "Improvements in or connected with telephonic instruments." A. L. Baird. (T. Barnet, New South Wales.) Dated January 10th. (*Complete.*)

633. "Improvements in printing telegraphs." F. Hachmann, C. Peifer, and C. Ernst. Dated January 10th. (*Complete.*)

635. "Improvements in electrical appliances for controlling the supply of gas to burners and effecting its ignition from a distance." C. Franzen. Dated January 10th.

655. "An improved locking and releasing device for electrical switches." F. P. Cox. Dated January 11th.

656. "An improvement in electrical switches." F. P. Cox. Dated January 11th.

657. "An improved electrical fuse-holder." F. P. Cox. Dated January 11th.

672. "Improvements in continuous current electric dynamos or generators for train lighting purposes." H. W. Wilson. Dated January 11th.

690. "Improvements in means for forming eyes on wire and other ropes, especially applicable to span wires for overhead conductors in electric tramway systems." E. H. Tyler. Dated January 11th.

699. "Improvements on and relating to electric furnaces for the production of calcium carbide and other substances." Tinker and Holliday, Ltd., and W. Cardno. Dated January 11th.

710. "Improvements in or relating to apparatus for electrically controlling mechanical movements." P. E. E. Raverot and P. F. L. Belly. Dated January 11th. (*Complete*)

764. "Hollow or recessed punches used in connection with Wheatstone's automatic telegraphy or any other systems of automatic transmission." J. W. Wilmott. Dated January 12th. (*Complete*)

813. "An improved electrical signalling and telegraphic apparatus." J. C. Schafer, E. Renz, and P. Lippold. Dated January 13th. (*Complete.*)

825. "Improvements in electrical measuring instruments." A. F. Harris. Dated January 13th.

864. "Improvements in electric arc lamps." W. J. L. Sandy and T. Geer. Dated January 13th. (*Complete.*)

903. "Improvements in telephone exchange switchboards." A. Eckstein and W. A. Guthrie. Dated January 14th.

906. "An improved magnetc-electric generator and automatic pull and circuit closer." G. W. T. Shrubshall. Dated January 14th.

907. "Improvements in transmitting printed telegraphic messages." A. Silbermann. Dated January 14th. (*Complete.*)

918. "Improvements in enclosed electric arc lamps." W. J. Davy. Dated January 14th.

925. "Rotary converters for single-phase alternating currents." M. Deri. Dated January 14th. (*Complete.*)

934. "Method of and apparatus for electrically transmitting orders, signals, or indications from one place to another." A. U. Alcock. Dated January 14th.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS.

*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

### 1897.

19,445. "Improvements relating to the distribution of electrical energy by means of polyphase currents, and to induction coils or transformers therefor." H. H. Lake. (Prof. G. Grassi and D. Civita.) Dated August 23rd, 1897. An induction apparatus or transformer is employed in systems with polyphase currents to obtain a single alternating current for lighting purposes, measuring, &c. Motors or the like are supplied by the polyphase current. A device suitable for a triphased current is as follows:—The laminated iron core has three limbs, A, B, C, wound with the three wires. The central limb may be wound oppositely to the others or in the same direction. The secondary coils may be wound upon the central link, B, or upon the limbs, A and C, only, or the coils may be joined in series. For currents having more than three phases, the transformer has a corresponding number of limbs. 4 claims.

19,707. "Improvements in supports for armature shafts." W. R. Thompson. Dated August 26th, 1897. The armature shaft of an electric generator or motor is supported in such a manner that it is capable of a slight longitudinal movement during the running of the machine, so as to prevent the brushes from continually bearing on the same part of the commutator. To the supports of the armature shaft are secured a yoke carrying a screw-threaded tube in which is mounted one end of a spindle, the opposite end of which rests in a conical recess in the end of the armature shaft. A sleeve acted on by a spring is arranged to slide upon the spindle, and between its head and that of the tube are arranged ball bearings. 2 claims.

19,719. "Improvements in methods of and means for electrical conversion and distribution." B. G. Lamme. Dated August 26th, 1897. Relates to rotary converters for converting alternating (multiphase) currents into direct currents, particularly for supplying a three-wire direct current system from alternating current circuits. Means are also provided whereby a plurality of different voltages may be secured in connection with an alternating current circuit and a rotary converter. Direct current motors may be run at varying speeds by varying the counter electromotive forces. A rotary converter is shown in which multipolar field magnet is of ordinary construction, except that the pole pieces are preferably shorter and wider, and may be provided with coils. The armature is of the iron-clad type, and the winding is of the usual direct-current generator closed coil type, and connected at one end to the segments of the commutator, on which bear the brushes, and at the other end to collecting rings, which also bear brushes. Four rings and four brushes are employed, the machine being used for the transformation of two-phase alternating currents. Under these conditions the armature rotates, direct currents being taken off by the brushes. In another arrangement for obtaining various electromotive forces in the working circuits, single coil transformers are arranged in the place of the transformers. Motors are controlled by varying the counter electromotive force. 6 claims

### 1898.

121. "Improvements in electric meters." E. Batault. Dated October 1st, 1898. Relates to an electric meter constituted by an electric motor and a registering device. Consists of a shunt electromagnet with rings about its poles, and with its armature movable round its centre, of a rotating disc with a metallic pin, and of series coils wound through the core, about a portion only of the cross section of the shunt magnet core. 11 claims.

571. "Improved means for making electrical connections upon railway trains." W. Brierley and R. Foster. Dated October 8th, 1898. Relates to the means for making the electrical connections for signalling between various carriages. For this purpose, fixed round the coupling at each end of each hose pipe, is a ring which embraces the coupling and also surrounds the end of the hose pipe. The ring is fitted with two or more electric spring "pushes" projecting from the face of the ring at diametrically opposite points outside the coupling in such a way that upon coupling up the vacuum hose pipes the "pushes" shall be forced together compressing the springs. The inner ends of the "pushes" are connected to the connecting wires which pass along the side of the carriage and communicate in the usual way with "pushes" in each compartment of the compartment. 2 claims.

932. "Improvements in the manufacture or production of electrodes for secondary batteries." C. Pollak." Dated October 12th, 1898. Relates to the preparation of electrodes for accumulators by the action of electric currents whose voltage does not exceed two volts per cell, and may be regulated by insertion of counter electromotive forces without the aid of resistances. For the purpose of preventing the direct formation of peroxide and producing lower stages of oxides on the electrodes, which can be subsequently transformed by the usual treatment into positive or negative accumulator electrodes. 1 claim.

1,145. "Improvements in electric cables." G. C. Allingham and W. Fennell. Dated October 14th, 1898. Relates to twin electric cables. The cables comprise two cores, each core being made up of a single row of conductors of circular cross section and equal size covered with a suitable insulating material. The conductors forming the core are held in position by dies while the insulating material is put round them. Two cores thus formed are placed together with their major cross sectional dimensions parallel, and a protective covering is applied. If desired, further insulating covering is applied according to the uses to which it will be subjected. The dimensions of the cores are so arranged that the cores when together approximate to a square cross section. 3 claims.

1,735. "Improvements in electrical accumulators or storage batteries." A. G. Adamson, T. W. Allan and Allan & Adamson, Limited. Dated October 13th, 1898. Relates to the construction of hollow frame supports for the active material in electrical accumulators. Consists of a hollow frame having lattices with bevelled, round or concave surfaces extending across its sides, and having the surfaces of these lattices on the inside of the frame so as to lock as well as support the paste, the frame, lattices and lug being cast in one piece of any suitable metal or alloy. 1 claim.

1,887. "Method of and means for enabling code or cypher printing or signalling to be effected by means of the ordinary keyboards of type-writing machines, telegraphic apparatus, type composing machines, or the like." J. Ballot. Dated September 13th, 1898. This invention has for its object to enable correspondence, or other communications, or telegraphic messages, to be readily printed, composed in cypher or code, by means of an ordinary keyboard such as is used for typewriting machines. The levers of the keyboard are marked with letters in the ordinary way, but on the keys caps are fitted with different letters on them from those of the keys, the caps of the instrument that is to print the message, &c., in code or cypher, being arranged in such order that the cap letters represent the letters of the ordinary word, and the letters of the keys and type-holders represent the corresponding code letters, while on the translating instrument the caps are fitted upon the keys in such order, that the cap letters represent the code letters and the key letters the ordinary words. 5 claims.

2,382. "Improvements in or relating to electric telegraphy." P. Picard. Dated October 12th, 1898. This specification relates to electric telegraphs, and deals in detail with various combinations, accompanied by seven sheets of drawings and does not permit of abridgment. 14 claims.

7,450. "Improvements in conductors, conduits, and collectors for electric railways and tramways." H. Daniel. Dated August 1st, 1898. Relates to conductors, &c., and consists of a slotted rail within which is enclosed an isolating wooden sleeper for carrying the conducting rails. The conducting rails, one preferably of iron and the other of copper, are mounted upon U-shaped carriers, which, by their elasticity tend to press the two conducting rails together, but they have also enough give to permit the blade-shaped collector to pass between the rails, and so a good contact is assured. Rectangular bent rubber guards are provided which prevent the entrance of water or dirt into the conduit; should, however, a little water find its way in, it will drain off through the openings in the rubber guards and the slotted rail. 4 claims.